Phase Linear

700

700B

Original

SERVICE MANUAL

700/700B
SERVICE MANUAL

Contents:

	p.
1-0. TECHNICAL SPECIFICATIONS.	3
2-0. OPERATING INSTRUCTIONS:	
2-1. Inputs	4
2-2. Speaker Impedance.	4
2-3. Thermal Protection	4
2-4. Amplifier Fusing	5
2-5. Speaker Fusing	5
2-6. Sound Reinforcement/Commercial Use . . .	5
2-7. Precautions.	6
3-0. CIRCUIT DESCRIPTION	7
4-0. SCHEMATICS and DIAGRAMS	9
5-0. TEST PROCEDURE.	19
6-0. TROUBLESHOOTING and ALIGNMENT	20
7-0. SERVICE BULLETINS and SUPPLEMENTS	26

THIS MANUAL IS INTENDED FOR USE ONLY BY QUALIFIED SERVICE PERSONNEL. HAZARDOUS VOLTAGES MAY BE ENCOUNTERED IN THE SERVICING OF A MODEL 700/700B AMPLIFIER. USE EXTREME CAUTION AND READ ALL INSTRUCTIONS CAREFULLY.

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prepared 6/76
revised 2/81

1-0. TECHNICAL SPECIFICATIONS

POWER OUTPUT: 345 WATTS PER CHANNEL MINIMUM RMS AT 8 OHMS FROM 20–20kHZ WITH NO MORE THAN 0.25% TOTAL HARMONIC DISTORTION.

TYPICAL THD: 0.01% at rated power into 8 ohms.

IM DISTORTION(60Hz:7kHz=4:1): less than 0.25% into 8-ohms at rated power.

SIGNAL-TO-NOISE RATIO: greater than 100dB below rated output.

INPUT IMPEDANCE: 100k-ohms nominal; reduces to 10k-ohms with input sensitivity controls shorted(fully CW).

DAMPING FACTOR: 1000:1 @ 1kHz

SLEW RATE: greater than 11 volts/microsecond

RISE TIME: less than 1.6 microseconds(small signal)

POWER BANDWIDTH: 12Hz–40kHz, +0-1dB

PHASE SHIFT: 0 degrees at 20Hz, lagging 10 degrees at 20kHz.

INPUT SENSITIVITY: 1.75v for rated output into 8 ohms.

2-0. OPERATING INSTRUCTIONS

2-1. Inputs

The model 700 or 700B can be operated in either the "normal" or direct coupled input modes. For high fidelity home use the unit should be operated in the NORMAL mode. This provides for AC coupling at the inputs which has a subsonic frequency rolloff of 6dB/octave with a corner freqency of about 15Hz. This can be effective in preventing loudspeaker woofer damage from DC or subsonics passed to the amplifier from a unit "upstream" in the signal path.

In the DIRECT coupled mode frequencies are amplified down to DC, at which there is a gain of 1. In some sound reinforcement applications it may be desirable to operate the unit in the DIRECT coupled mode.

The front panel LEVEL controls are merely sensitivity controls which affect only the input signal. They are not connected to the amplifier output stage and do not affect amplifier gain.

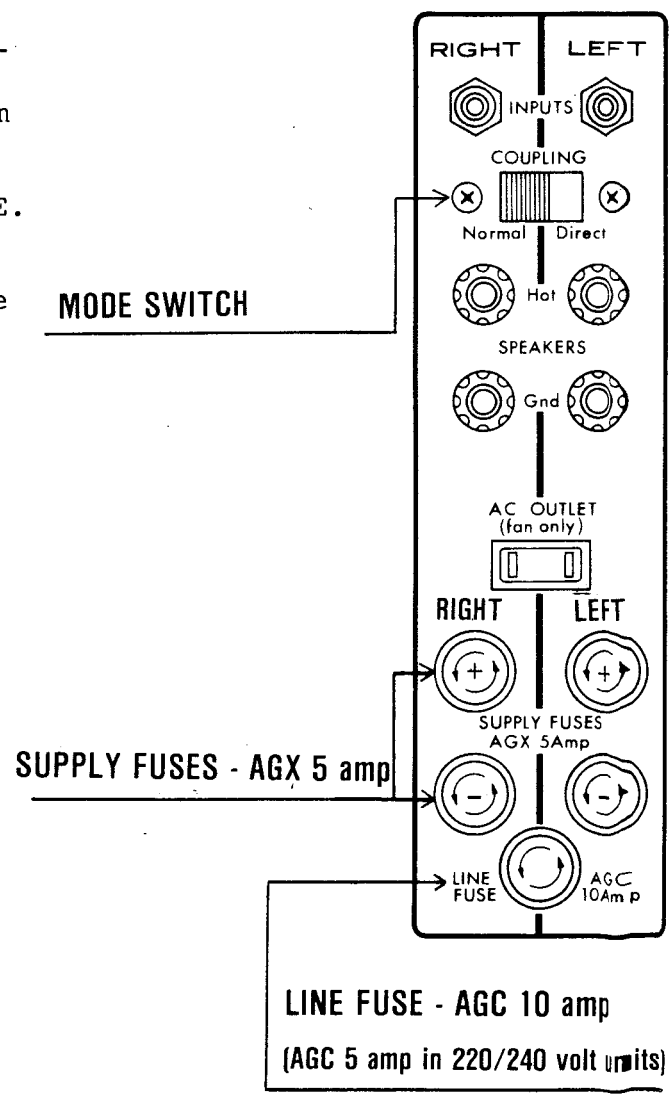
2-2. Speaker Impedance

The model 700/700B amplifier was designed to drive a speaker load impedance from 4-ohms to infinity. DO NOT DRIVE A SPEAKER LOAD OF LESS THAN 4-OHMS NOMINAL IMPEDANCE. It is permissible to drive the amplifier into an open load(nothing connected to the amplifier outputs.

Multiple speaker connections can be made to the 700/700B provided that the final nominal load impedance presented to the amplifier is not less than 4-ohms.

2-3. Thermal Protection

The 700/700B amplifier is equipped with a thermal cut-out switch in each channel. The switch activates at approximately 90°C ±5°. If the amplifier overheats and shuts down it is advisable to turn the POWER switch off to insure that the thermal switch contacts will not be subjected to the large current surge associated with turn-on.



2-4. Amplifier Fusing

The 700/700B amplifiers are factory-fitted with AGX-5 amp fuses in the supply and AGC-10 amp fuse in the line. AGX fuses can be substituted with any 1"(±1/8") fast-blow fuse of the same current rating. AGC can be substituted with a 1¼"(±1/8") fast-blow fuse of the same rating.

For operation of the amplifier other than home-use high fidelity, it is recommended that the AGX-5 amp supply fuses be replaced with AGX-8 amp fuses. This may be necessary if the amplifier is being used in a sound reinforcement application, for sine wave bench testing or if driving a nominal speaker load impedance of less than 8-ohms.

NOTE: NEVER USE GREATER THAN AN 8-AMP FUSE FOR SUPPLY FUSING.

2-5. Speaker Fusing

With the use of a high-powered amplifier it is important to realize the necessity for proper in-line loudspeaker fusing as an added measure of speaker protection. THE SUPPLY FUSES IN THE MODEL 700/700B ARE PRIMARILY FOR PROTECTION OF THE AMPLIFIER TO MINIMIZE DAMAGE TO THE AMPLIFIER SHOULD A MALFUNCTION OCCUR. Speaker protection is secondary and the amplifier supply fusing should not be relied on as a primary means of protecting the loudspeakers in the event of a malfunction.

> PHASE LINEAR HIGHLY RECOMMENDS AND ENCOURAGES THE USE OF ADDITIONAL IN-LINE FUSES FOR OPTIMUM SPEAKER PROTECTION.

Fusing information should be available from each loudspeaker manufacturer for each model produced. If fusing information is not available from the manufacturer the following equation is recommended for determining the correct speaker protection fuse:

$$I = \sqrt{\frac{P}{4R}}$$

where I is the current rating of the fuse in amperes, P is the maximum recommended peak power handling capability of the loudspeaker in watts, and R is the nominal speaker impedance in ohms. For example, an 8-ohm speaker capable of handling 200 watts of peak power should be protected with a 2.5-amp fast-blow fuse. NEVER USE SLOW-BLOW FUSES FOR SPEAKER PROTECTION.

The fuse should be placed in series with either the positive or negative speaker wire on each channel.

2-6. Sound Reinforcement/Commercial Use

Although not designed either electrically or physically for commercial use, the 700/700B amplifier can be used providing that the following precautions are taken:

1. The unit should be fan-cooled.
2. A speaker load impedance of greater than 4-ohms must be used. DO NOT DRIVE THE AMPLIFIER INTO A LOAD IMPEDANCE OF LESS THAN 4-OHMS! Serious damage to the output stage of the unit can result.

3. Do not exceed the recommended supply and line fuse values. It is recommended that for commercial applications the AGX5 supply fuses be replaced with AGX8 amp fuses. If, at continued high power levels the AGC10 line fuse continues to blow it is permissible to replace this with a AGC15-amp fuse. USE ONLY FAST-BLOW FUSES!
4. If the amplifier is to be rack-mounted it is important that additional support be provided for the power transformer. If the unit is rack-mounted by the front panel alone the chassis "ears" to which the aluminum front panel is bolted may tear away from the chassis. If this occurs it may be necessary to provide additional reinforcement to the chassis by mounting an L-bracket behind each chassis "ear". Chassis replacements are not cheap!

2-7. General No-No's

NEVER DRIVE THE AMPLIFIER INTO A SPEAKER LOAD IMPEDANCE OF LESS THAN 4-OHMS NOMINAL.

NEVER EXCEED THE RECOMMENDED SUPPLY AND LINE FUSE RATINGS.

NEVER EVER EVEN BEGIN TO THINK ABOUT PARALLELING THE TWO CHANNEL OUTPUTS TOGETHER TO FORM A MONO AMP. YOU'LL ONLY MAKE A MESS OF THE OUTPUT STAGE. AND A MESS OF YOUR HEAD AND POCKETBOOK. (The amplifier can be bridged at the inputs to form a mono amp provided the speaker load driven is greater than 8-ohms. Contact the factory for details.)

NEVER RACK-MOUNT THE AMPLIFIER WITHOUT PROVIDING ADDITIONAL SUPPORT FOR THE POWER TRANSFORMER.

And finally, a word about turn-off noise...

It is a characteristic of the 700 and 700B amps to display a delayed turn-off thump a few seconds after the unit is turned off. This is caused by the power supply discharging through the front end differential transistors. It should, however, be a fairly low level noise(it's not always a thump). If it is extremely loud and threatens loudspeakers refer to section 6-8.4 on page 26. Also be sure the speakers are externally fused per section 2-5 on the opposite page.

3-0. CIRCUIT DESCRIPTIONS

3-1. PL0171 Drive PC Board(Model 700)

Input signal is applied to the base of Q2 from one of two switch-selectable sources(S2). S2 applies the output of emitter follower Q1 or a signal applied from the DIRECT input jack. The RC combination in the emitter of Q1 serves as a time delay circuit to prevent turn-on transients from reaching the base of transistor Q2 for approximately one-half second. The output of the differential pair comprised of Q2 and Q3 is applied to a second differential pair, Q4 and Q5. Differential amplifier Q4 and Q5 provide single-ended output which is applied to the base of Q9. Q9 provides the final voltage gain to drive the predriver transistors Q10 and Q17. The PNP predriver Q17 serves as a phase inverter to drive the negative output driver transistor Q18. The emmitter of Q18 drives the paralleled emitter follower output transistors Q19, Q20, Q21, Q22 and Q23. The positive half of the signal is amplified by emitter follower Q10, which in turn drives the paralleled outputs Q11, Q12, Q13, Q14, Q15 and Q16.

Level control R4 controls the input signal applied to the base of Q2. It is operational only when the signal is received on the normal input jacks. R7 and R17 are D.C. offset adjustments which serve to null out small V_{be} differences between Q2 and Q3.

Diodes D5, D6 and D7 provide forward bias to the bias regulator transistor Q6. R36 adjusts the slight amount of forward bias necessary to provide a few milliamps of idling current in the driver transistors. This prevents crossover distortion.

The patented protection circuit consists of Q7, Q8 and their associated RC and diode networks. If the output current flowing through R48 and R69 becomes dangerously high, capacitors C19 and C20 acquire a voltage through R43 and R54 to cause Q7 and Q8 to turn on. Q7 and Q8 then cause D10 and D11 to also turn on. Drive current is shunted through D10 and Q11 around the predriver Q10, preventing an uncontrolled increase in output current. Diodes D10 and D11 prevent activation of the protection circuits when the amplifier is driving a reactive load. D12 and D13 are flyback diodes which prevent reverse overvoltage from appearing across the output transistors in the event an inductive load is switched.

S2 and S3 are switches designed to thermally activate(open) if the heat sinks become too hot for safe operation. They automatically close again once the temperature returns to the safe region.

3-2. PL14 and PL20 Drive PC Board(Model 700B)

Input signal is applied to the base of Q1. The output of the differential pair comprised of Q1 and Q2 is applied to the second differential pair Q3 and Q4. This second differential provides single-ended output which is applied to the base of Q5. Q5 provides the final voltage gain to drive the predriver transistors Q7 and Q10. The PNP predriver serves as a phase inverter to drive the negative output driver transistor Q12. The emitter of Q12

drives the paralleled emitter follower output transistors Q14, Q16, Q18, etc. The positive half of the signal from Q5 is amplified by emitter follower Q10, which in turn drives the paralleled outputs Q13, Q15, Q17, etc. through output driver Q11.

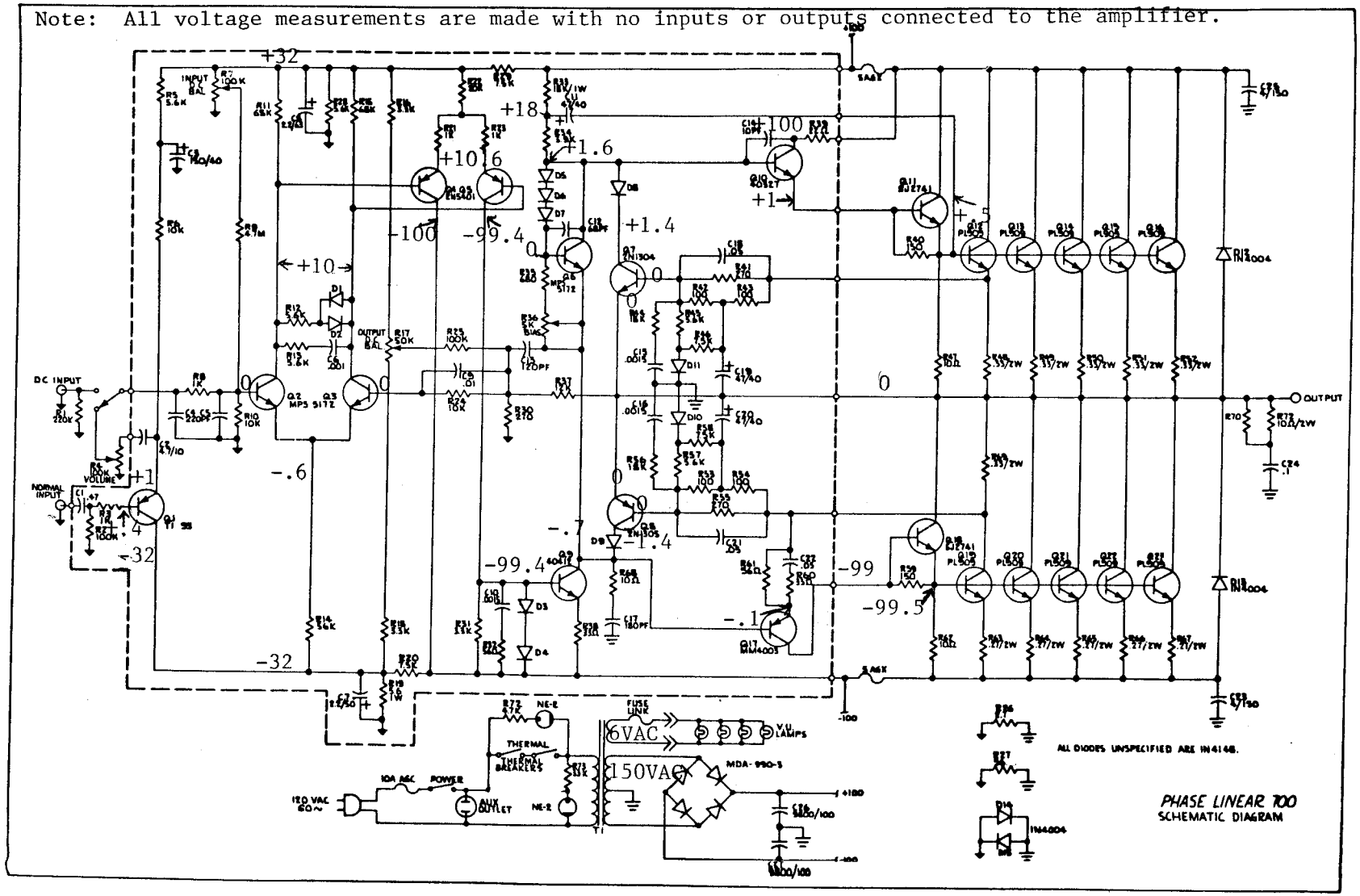
Diodes D6, D7 and D8 provide forward bias to the output bias regulator transistor Q6. R20 adjusts the slight amount of idle current in the driver transistors, which minimizes crossover distortion.

The protection circuits and thermal switches operate the same as discussed earlier with the PL0171 PC drive board.

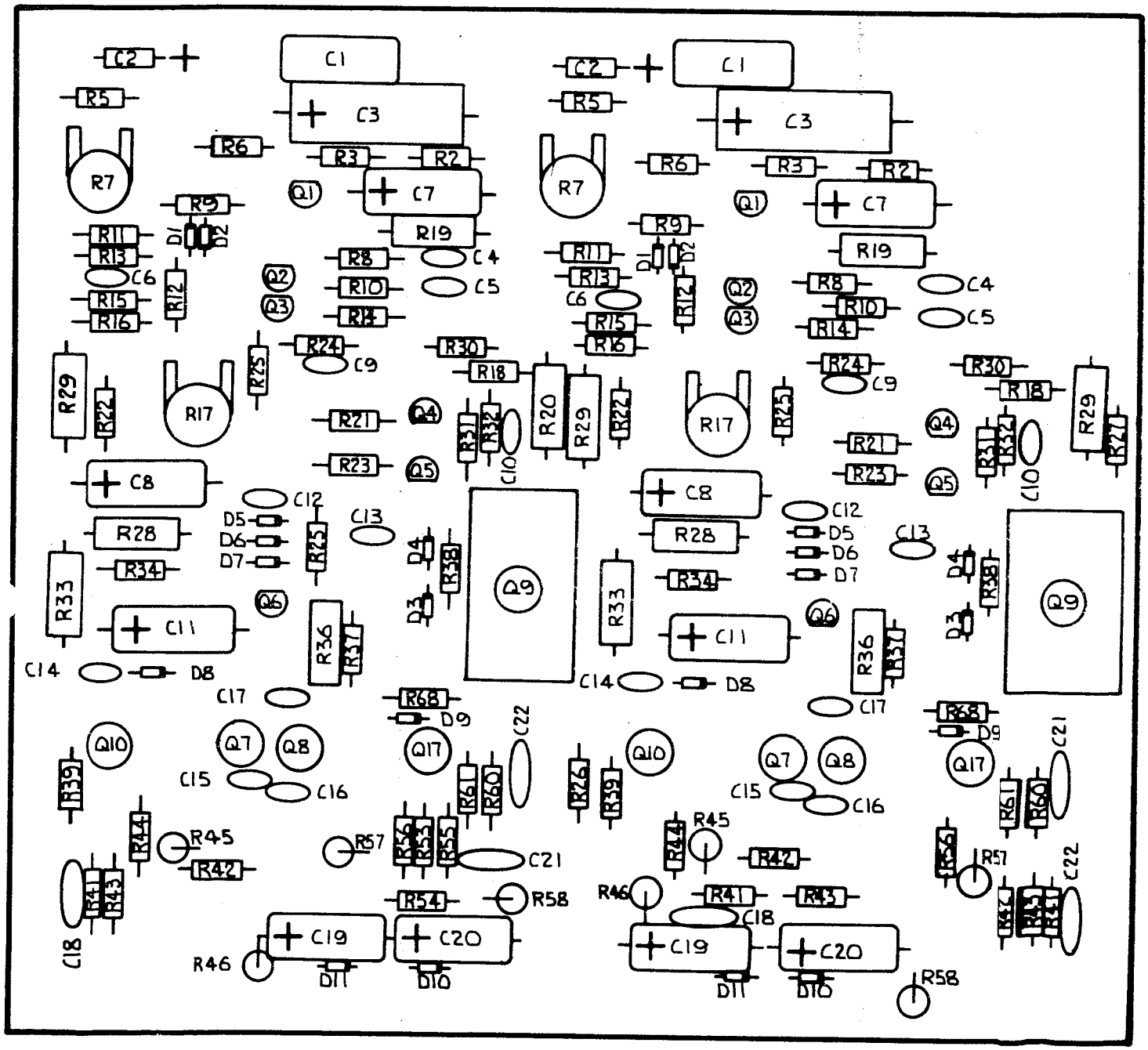
4-0. SCHEMATIC and ASSEMBLY DIAGRAMS

	p.
Schematic Diagram, PL0171(700)	9
PCB Assembly Diagram, PL0171	10
Schematic Diagram, PL14(700B)	11
PCB Assembly Diagram, PL14	12
Schematic Diagram, PL20(700B)	13
PCB Assembly Diagram, PL20	14
PCB Assembly Diagram, PL17 Meter PCB(700B)	15
Wire Point PCB Connection Diagram, PL0171	16
Wire Point PCB Connection Diagram, PL14	17
Wire Point PCB Connection Diagram, PL20	18

Note: All voltage measurements are made with no inputs or outputs connected to the amplifier.

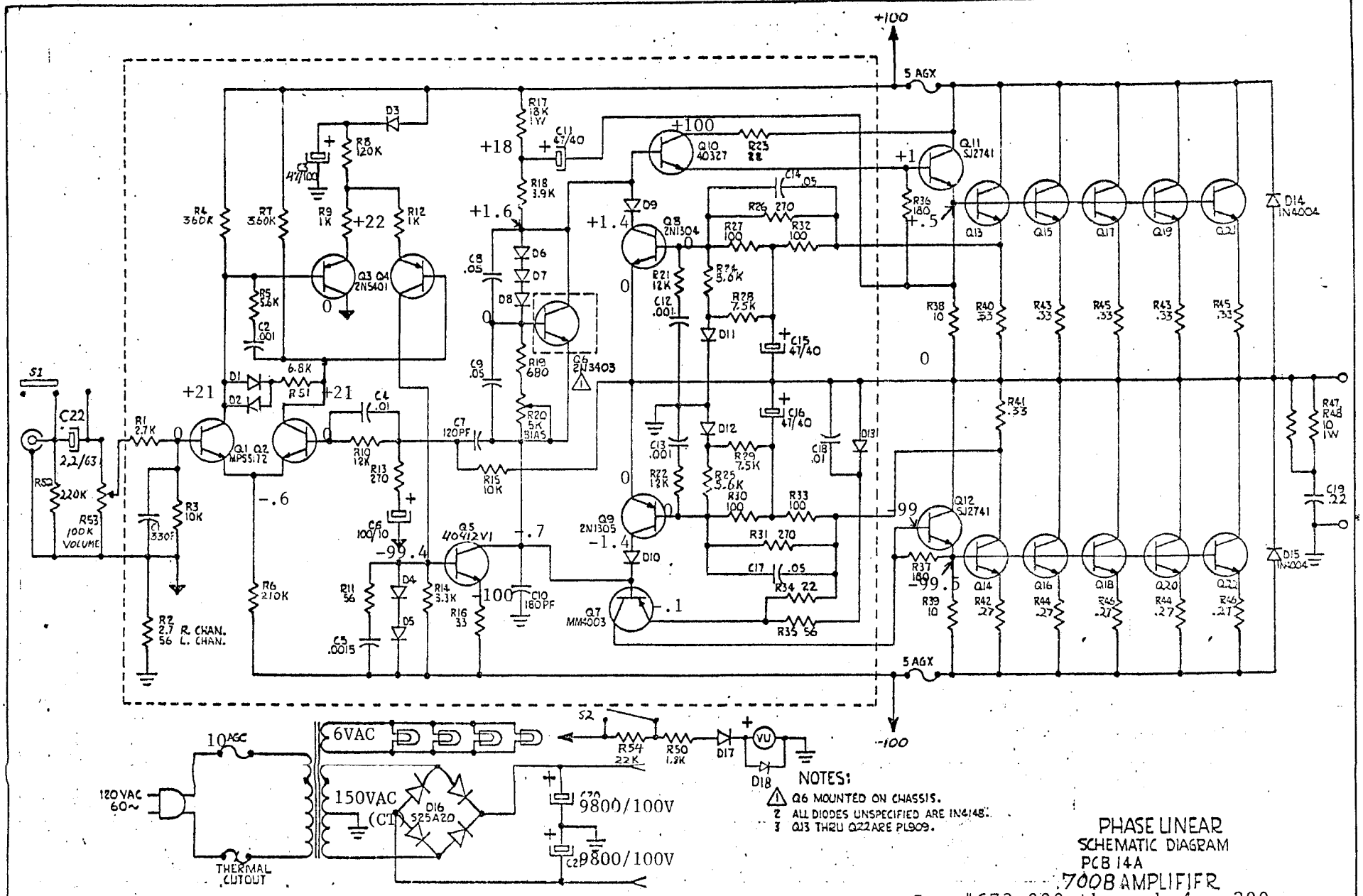


Schematic Diagram, PL 0171 PCB(700)



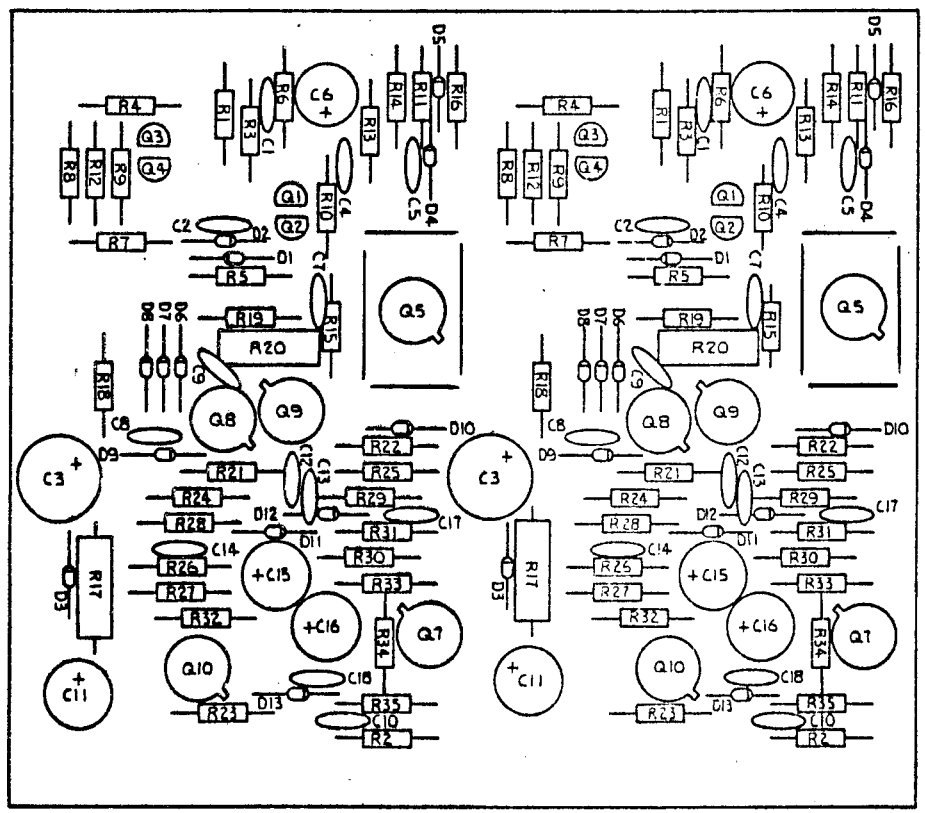
Assembly Diagram, PL0171 PCB(Model 700)

Note: All voltage measurements are made with no imputs or outputs connected to the amplifier.



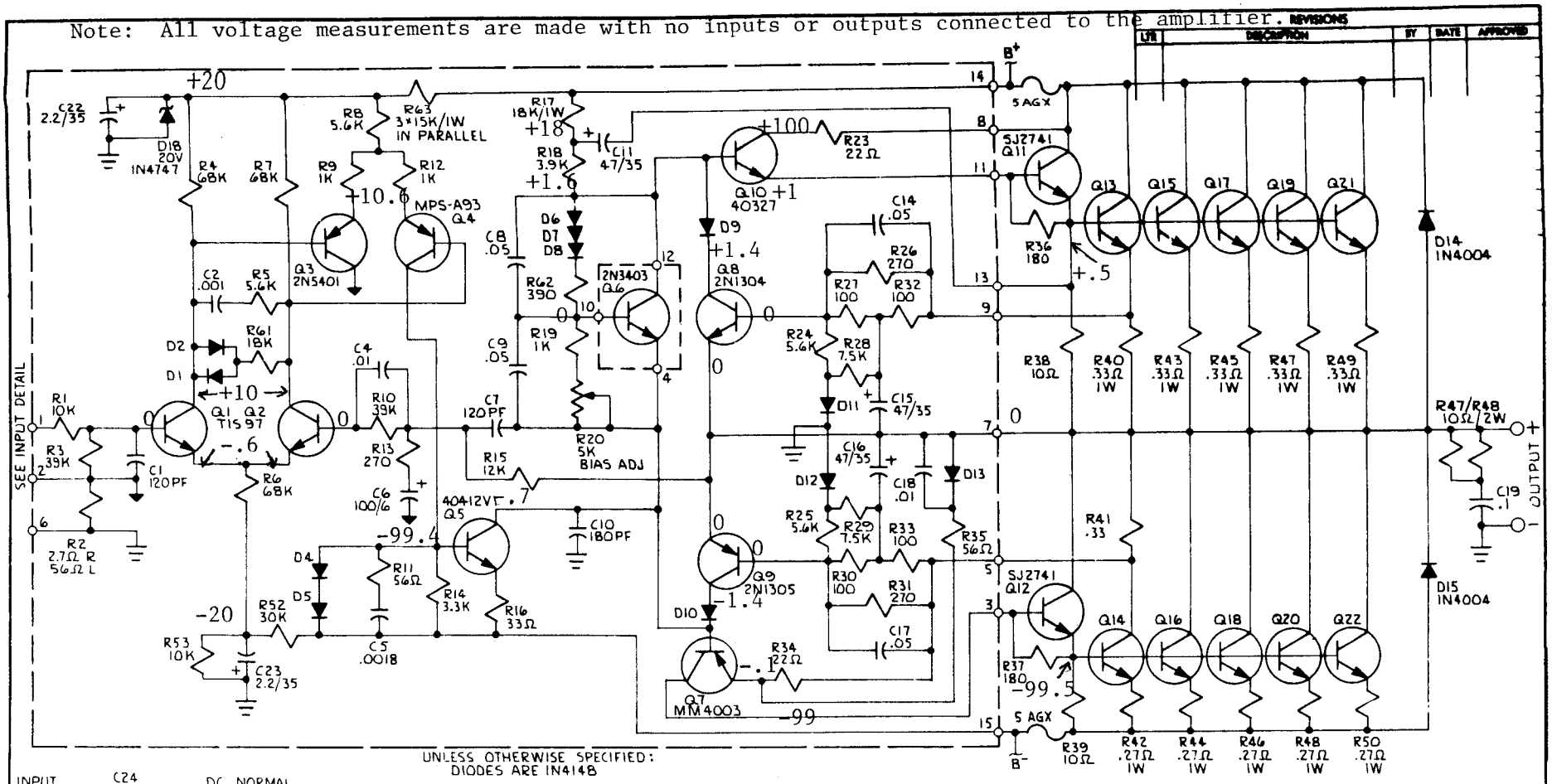
NOTES:
1. Q6 MOUNTED ON CHASSIS.
2. ALL DIODES UNSPECIFIED ARE IN4148.
3. Q13 THRU Q22 ARE PL909.

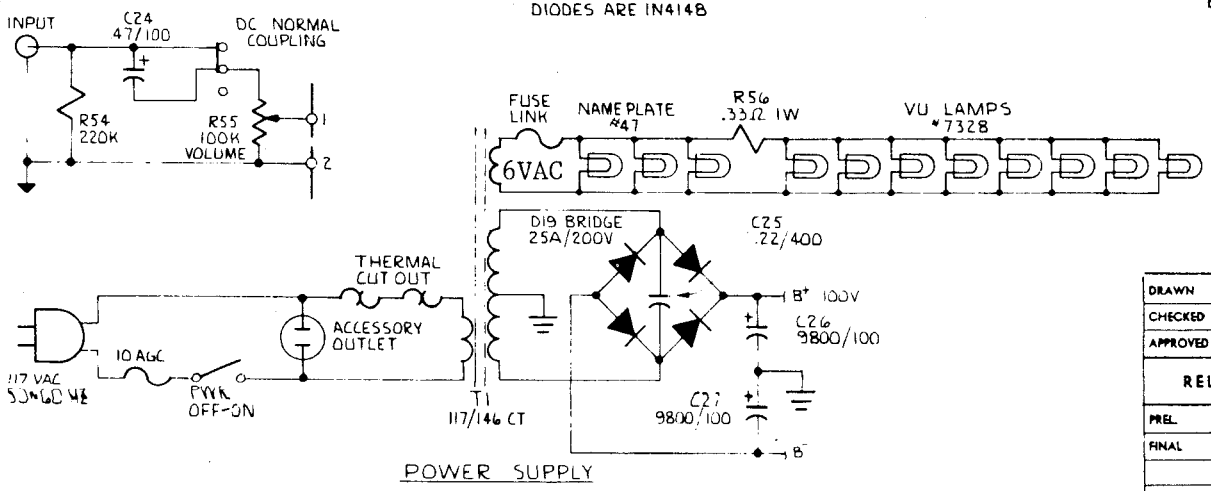
PHASE LINEAR
SCHEMATIC DIAGRAM
PCB 14A
700B AMPLIFIER
Ser. #673-000 through -200

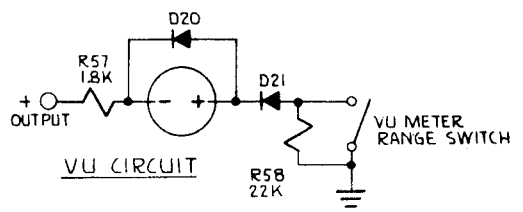


PHASE LINEAR
ASSEMBLY PCB14A
700B AMPLIFIER
Ser.#673-000 through 474-200

Note: All voltage measurements are made with no inputs or outputs connected to the amplifier.



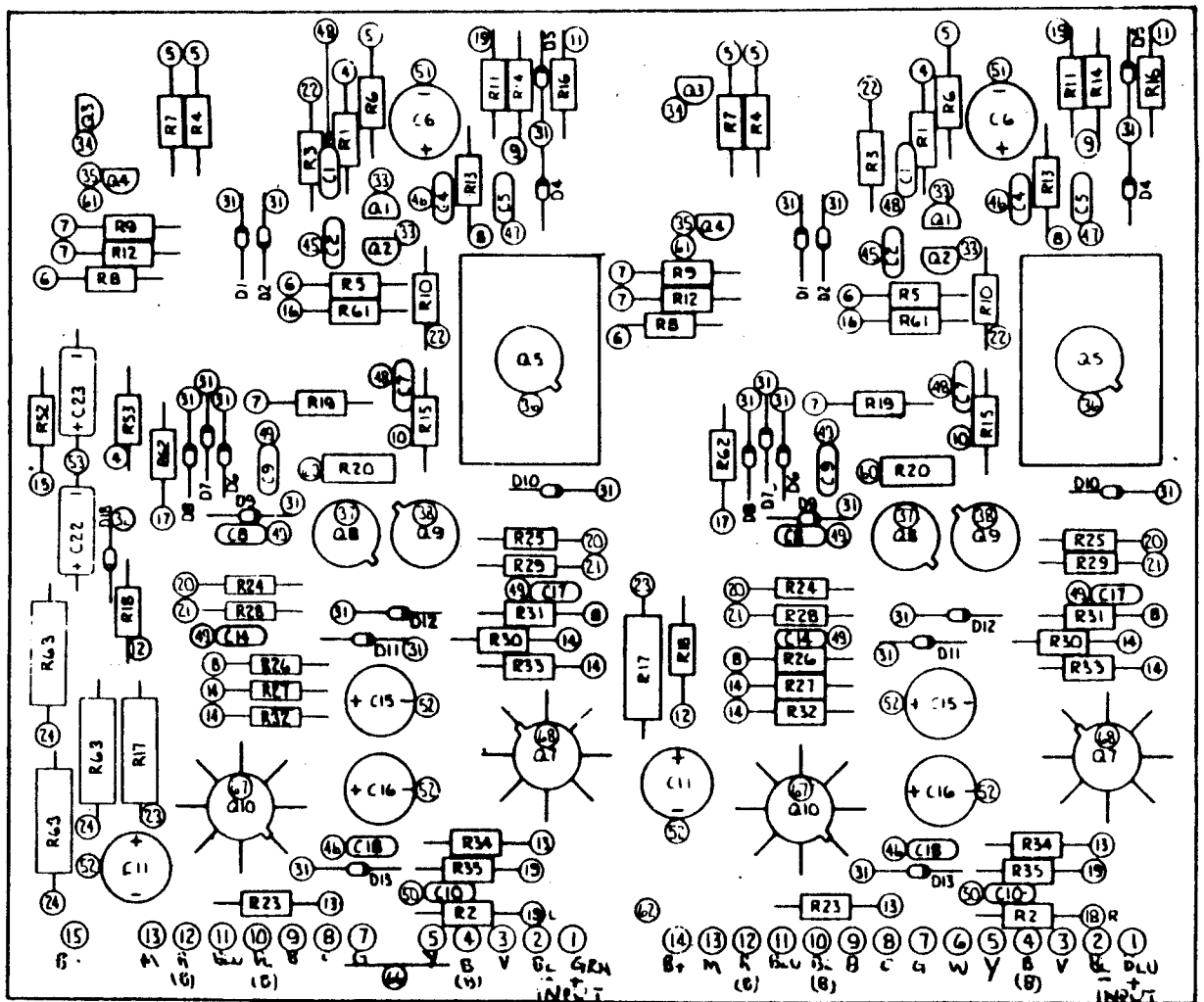




DRAWN KNOBEL 9/9/74	Phase Linear		
CHECKED / /			
APPROVED / /	ASSY 700B AMPLIFIER		
RELEASE STATUS			
PREL / /			
FINAL / /			
/ /	SIZE C	DWG. NO. 402461	REV. E
/ /			
DO NOT SCALE DWG.	SCALE:		SHEET 1 OF 1

Schematic Diagram, Model 700B PL20 PCB Ser.#574-000 through 57[illegible]200,

REVISIONS				
LTR	DESCRIPTION	BY	DATE	APPROVED
E	UPDATED PARTS LIST & DWG.	S P	10-1-75	



700B UNIVERSAL PCB

SEE 402461 FOR SCHEMATIC

PL20B -02 ASSY

C-SAME AS 01 EXCEPT R63 ON BACK OF PC B.
01-SAME AS 02 EXCEPT C5 IS .0015MF.

DRAWN	KNOBEL	5 2 74
CHECKED		7 23 74
APPROVED		

RELEASE STATUS

REMOVE BURRS AND SHARP EDGES

DO NOT SCALE DWG

Phase Linear

PCB ASSY
700B PWR AMP
PL20 PCB

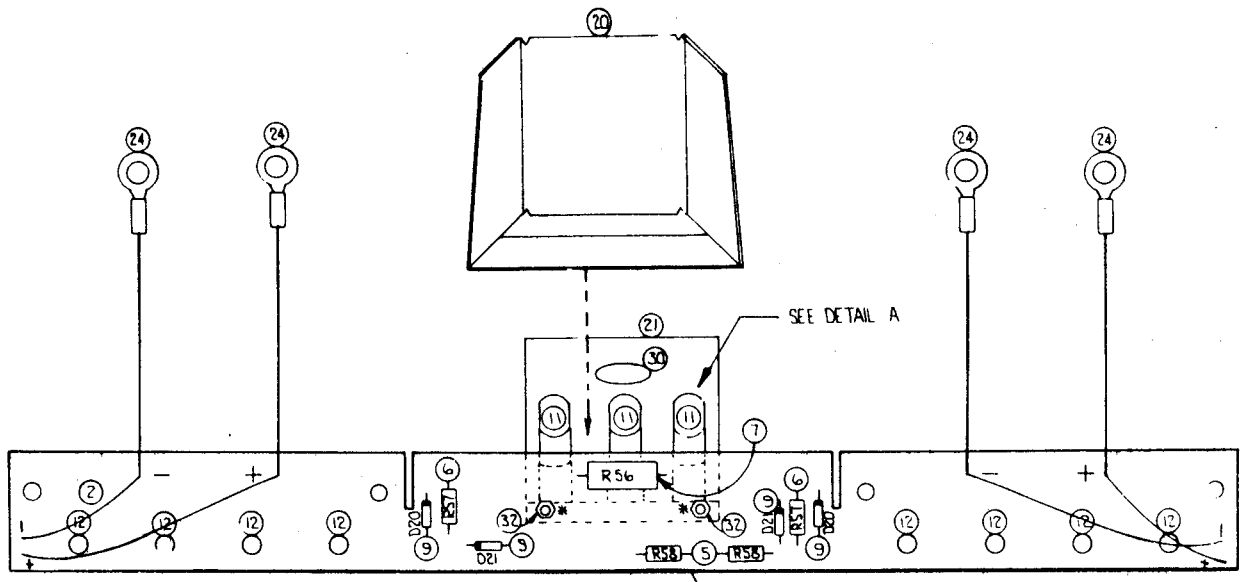
SIZE	DWG NO	REV
C	402453	F

SCALE | SHEET 1 OF 1

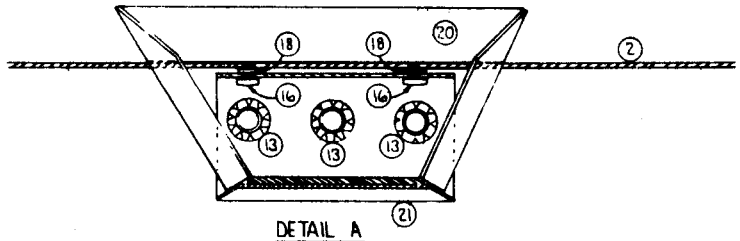
ATTACHMENTS 012345

DIAGRAM III-6

REVISIONS				
LTR	DESCRIPTION	BY	DATE	APPROVED



01 ASSY PL17 64500



DETAIL A

NOTE
FOR SCHEMATIC SEE DWG 402461

UNLESS OTHERWISE SPECIFIED DIM AND TOL ARE IN INCHES AND SHALL BE INTERPRETED PER ANSI Y14.5-1966.
TOLERANCES ARE
1 DEC ±: .1 3 DEC ±: .005
2 DEC ±: .01 4 DEC ±: .0005
ANGLES ±: 0° 30'
REMOVE BURRS, BRK SHARP EDGES MACH SURFACES 125

MAT'L:
FINISH:
BAT:

DRAWN	PICKENS	9/17/74
CHECKED	[illegible]	9/18/74
APPROVED		/ /

RELEASE STATUS

PREL	/ /
FINAL	/ /
	/ /
	/ /

DO NOT SCALE DWG.

Phase Linear

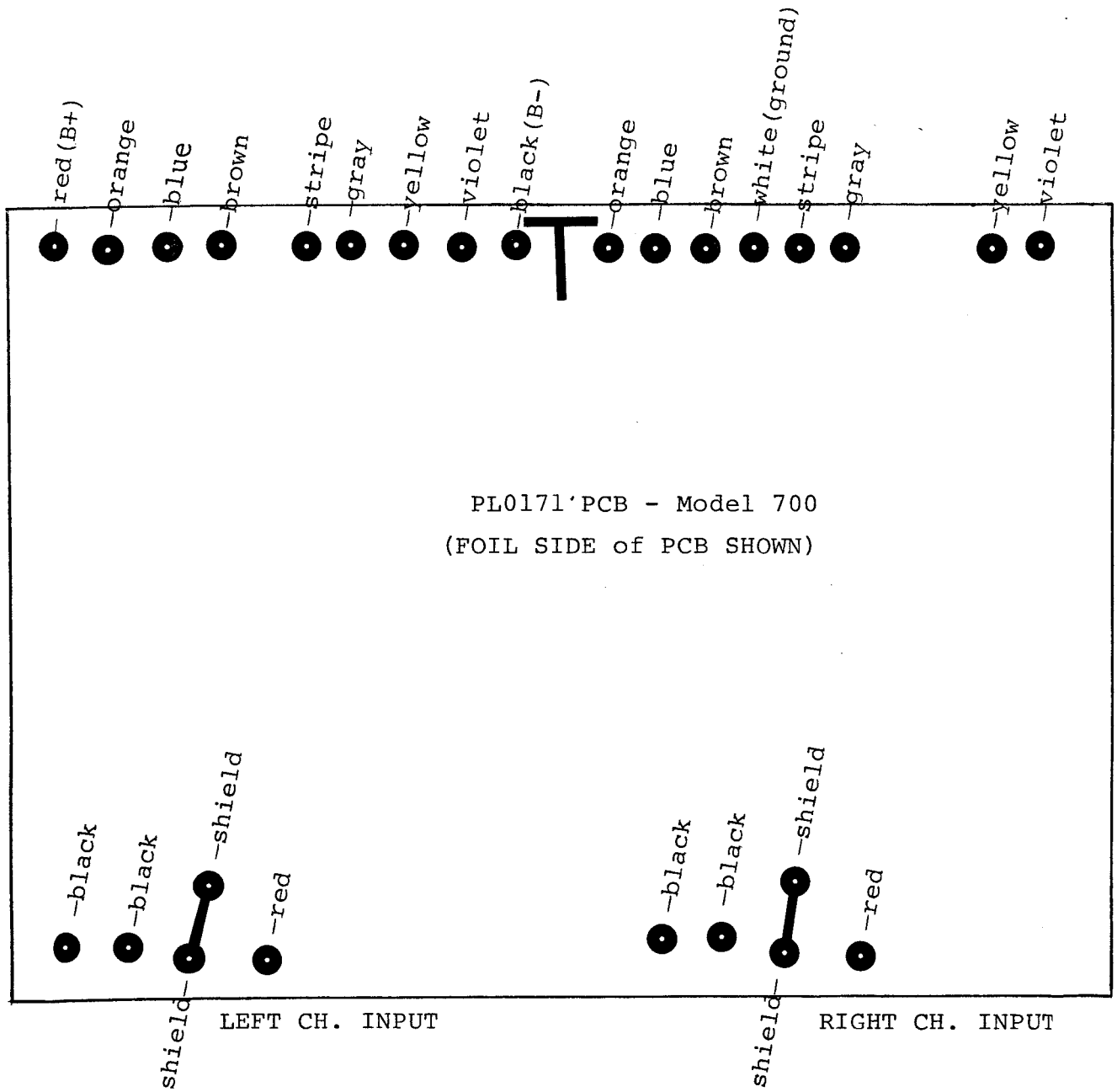
PCB ASSY
700B METER BOARD

SIZE		DWG. NO.	REV.
C	PL17	402456	A

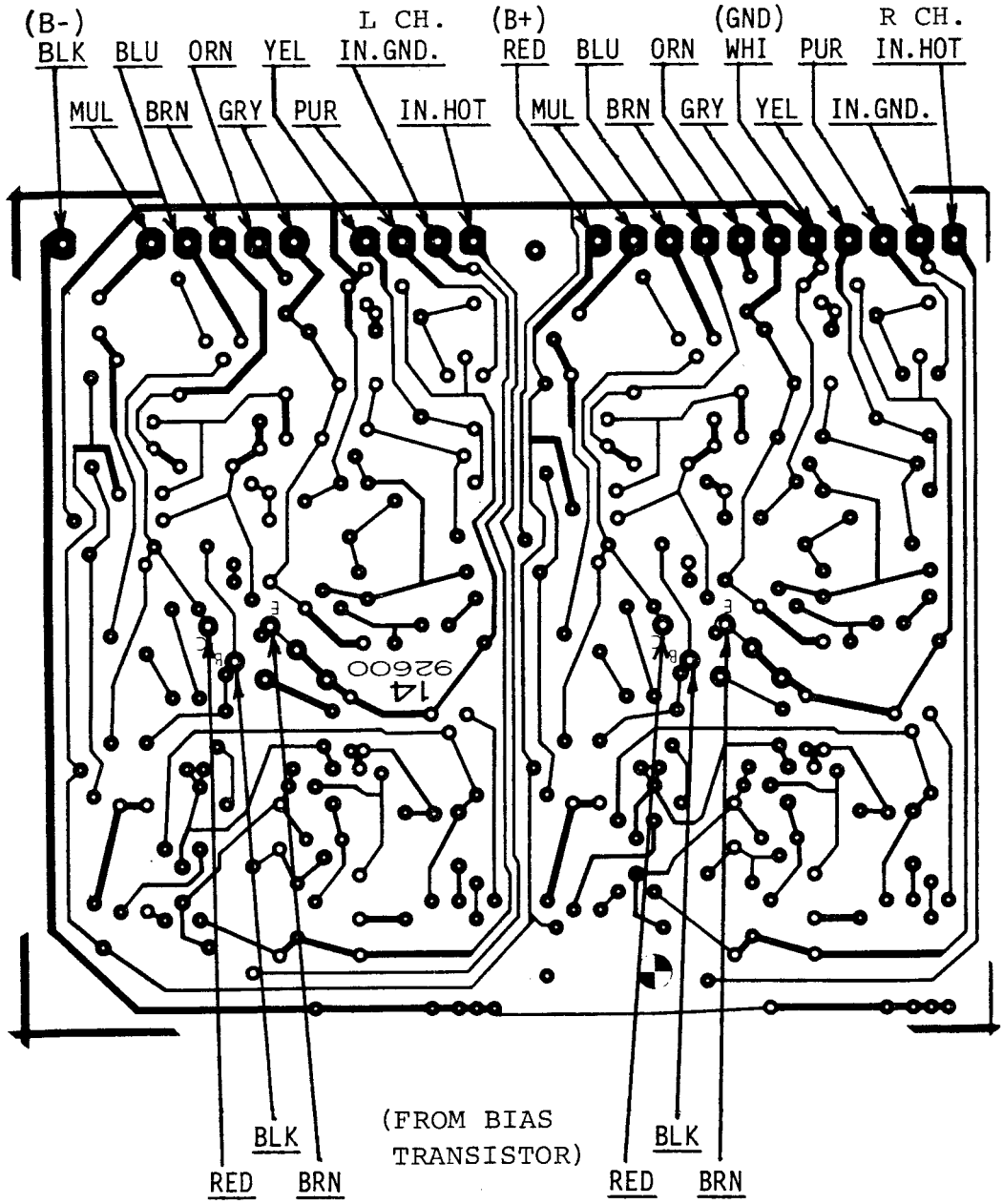
SCALE:

SHT 1 OF 1

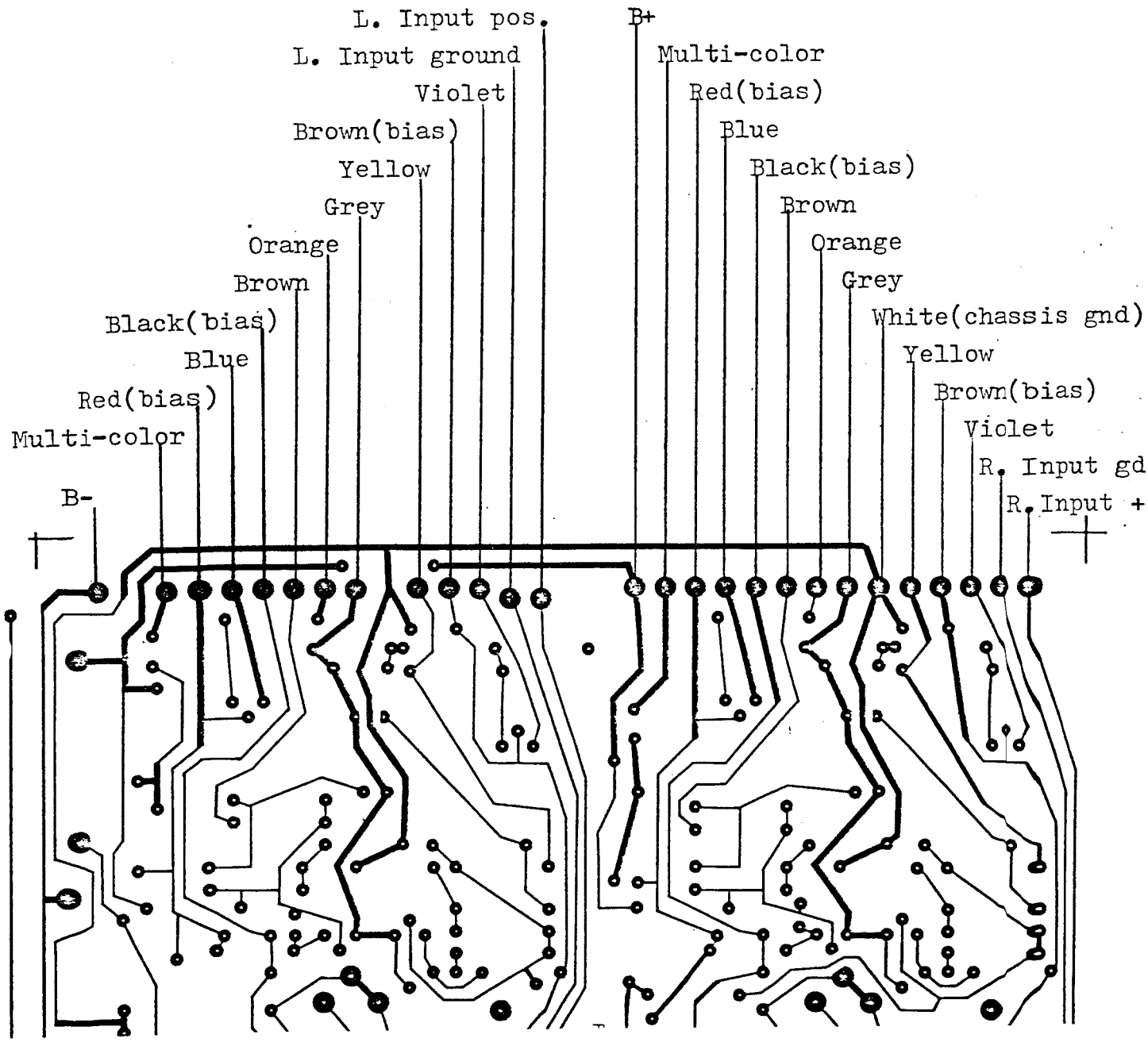
DIAGR III-7



Wire Harness Connection Point Diagram,
PL0171(Model 700, all serial numbers)



Wire Harness Connection Point Diagram, PL14 PCB(Model 700B, Ser.#673-000 through 474-200)



Wire Harness Connection Point Diagram,
PL20 PCB(Model 700B, Ser.#574-000 through
574-200, and Ser.#1000 through 7000)

5-0. TEST PROCEDURE

Required test equipment:

Audio Sine Wave Generator
VOM or DVM
High-impedance oscilloscope
THD Analyzer
250-watt 8-ohm test load resistor
Variable Line Transformer(VARIAC)

5-1. Power supply. Before plugging in the AC line cord check all fuses. Verify AGX5-8 amp(or equivalent)fuses for the four supply fuses and AGC10 amp(or equivalent)fuse for the line. If the unit is wired for 220-240V operation verify AGC5 amp line fuse; the supply fuses should be the same as for 117V operation.

CAUTION: If any fuse is discovered blown, do not energize the amplifier, even after replacing the blown fuse(s). Refer to section 6-1 to properly energize the unit without causing possible further damage to the output stage.

5-2. Energizing the unit. Plug the line cord into a variable line transformer(VARIAC)and slowly turn it up to 117VAC(or 220VAC)as required. If a line transformer is not available it will be necessary to plug the unit directly into a working AC outlet and hope for the best. Verify that the power on indicator(center display script window on the 700B)and meter lamps illuminate.

NOTE: The display meters may "jump" when the unit is turned on but should immediately settle. This is a normal condition.

5-3. Output signal with no load. Monitor the left channel output with the scope and AC voltmeter. DO NOT connect any other load to the outputs at this time. Drive the left channel input with a 2kHz sine wave until the output wave form is well into clipping. Verify that the clipping is symmetrical on both halves of the wave form. Repeat for the right channel.

5-4. Output with 8 ohm load. Connect an 8-ohm 250-watt test load resistor to the left channel output terminals and monitor the left channel output. Apply a 2kHz signal to the left channel input and verify an RMS output of at least 53 volts before clipping. Repeat at 20Hz, 200Hz, and 20kHz for both channels.

5-5. Distortion. Monitor the left channel output with a THD analyzer. With an 8-ohm load connected also to the left channel output, drive the left channel to 53VRMS and verify a THD +N of less than 0.25%. Repeat this procedure with the right channel. This same procedure may be used to measure for IM distortion of 0.25% or less.

NOTE: It may be necessary to utilize the high filter in the THD analyzer if it is so equipped.

5-6. Offset. With no inputs connected to the amplifier, measure across the output terminals of each channel for presence of DC offset voltage and verify less than ±50mV.

5-7. Short circuit test. Drive the left channel with a 200Hz signal to an output level of 53VRMS. Now short the output terminals with a jumper wire for 2 to 4 seconds. Remove the jumper wire and verify that the amplifier resumes normal operation. Repeat for the right channel.

6-0. TROUBLESHOOTING AND ALIGNMENT PROCEDURES

NOTE: Most transistors and diodes in the 700/700B can be checked in-circuit using ah ohmmeter on the Rx1, Rx10 or 2K scale. With the 700 UNPLUGGED from the line voltage source, measure the forward-biased resistance of the particular diode or transistor junction and verify a reading of 400–700 ohms on a typical DVM for a good device. Actual readings will vary from meter to meter, and some meters do not have sufficient test voltage to turn on a semiconductor. Nevertheless the shorted or open device is usually revealed quickly using this in-circuit method.

CAUTION: BEFORE MAKING ANY MEASUREMENTS INTERNAL TO THE 700 UNLESS OTHERWISE SPECIFIED, BE SURE THAT THE LINE CORD IS UNPLUGGED AND THE POWER SUPPLY CAPACITORS ARE DISCHARGED. WAIT AT LEAST FIVE MINUTES AFTER UNPLUGGING THE AMPLIFIER TO ENSURE THAT THESE CAPACITORS ARE DISCHARGED, OR DISCHARGE THEM BY PLACING A 5–20 OHM(MINIMUM 5-WATT RATING) RESISTOR ACROSS THE CAPACITOR TERMINALS.

ONLY QUALIFIED PERSONNEL WITH PROPERLY INSULATED AND PROTECTED EQUIPMENT SHOULD ATTEMPT SERVICING OF THE 700 WITH THE POWER ON.

6-1. POWER SUPPLY MALFUNCTION

6-1.1. Blown line fuse.

a) Disconnect the positive and negative leads of the bridge rectifier(either at the rectifier or at the filter capacitor terminals)and measure for shorted diodes.

b) Check for shorted power supply filter capacitor.

c) Disconnect the power transformer secondary leads from the bridge rectifier and measure the transformer for primary-to-secondary short. This, incidently, is an extremely rare occurrence.

6-1.2. Blown supply fuse(s).

NOTE: If any of the supply fuses open by a simple break in the filament, replace the fuse(s) and retest the amplifier. If the fuse displays any remote trace of a black or silver vaporized appearance on the glass wall DO NOT REPLACE THE

FUSE(S) AND ENERGIZE THE UNIT AT THIS POINT since this may only cause further damage to the output stage.

First, perform the following test to check for defective output transistors:

IT IS NOT NECESSARY TO REMOVE EACH AND EVERY OUTPUT TRANSISTOR OR OUTPUT DRIVER TO LOCATE A SHORTED DEVICE.

Use a DVM or VOM set to the lowest resistance scale. Connect the negative lead to the collector bus wire of the suspected bank of output devices. Starting with the top transistor, measure the resistance at its emitter with the positive lead. If the outputs in that bank are good you will get a reading just slightly lower than a typical semiconductor junction reading, and you can go on to the next bank of output devices.

If that transistor, or any in that bank of transistors is shorted, the meter will indicate a fraction of an ohm. Note the resistance and proceed from emitter to emitter (in that bank) testing in turn each device. The meter will indicate a fraction of an ohm on each emitter because the transistors are connected in paralled through their emitter resistors. However, when the defective one is tested, the meter will indicate slightly less (about .5 ohm) than it did on the good transistors.

If all transistor emitters in a bank have the same identical reading, suspect the output driver transistor as being shorted. Also, if an analog ohmmeter is being used care is required in reading the meter to spot the small differential in the shorted output emitter reading.

IMPORTANT: WHENEVER ANY OUTPUT TRANSISTOR HAS BEEN REPLACED IT IS NECESSARY TO PERFORM STEP 6-1.3 TO VERIFY PROPER CURRENT SHARING OF ALL OUTPUT TRANSISTORS.

WHEN REPLACING OUTPUT TRANSISTORS IT IS IMPORTANT THAT ONLY THE SAME MAKE AND NUMBER BE INSTALLED IN ANY ONE CHANNEL. PLEASE REVIEW SERVICE BULLETIN 1-80 IN THE BACK OF THIS MANUAL.

6-1.3. Current sharing test. This test is necessary to verify that ALL output transistors are operating properly, ensuring a permanent repair. Although the amplifier will probably meet all specs without all outputs operational, increased current loading of the remaining outputs will result in a significant reduction in reliability and thermal stability.

a) With an 8-ohm test load connected to the output terminals of the left channel, drive the left input with a 200Hz signal to obtain a 53VRMS output. Turn down the line voltage on the VARIAC to about 75–80V. (If a VARIAC is not available, drive the inputs such that the amplifier is well into clipping.)

b) Using a DC voltmeter measure the voltage drop across the output transistor emitter resistors in each output bank. Verify that there is between 140 and 180mV DC across each emitter resistor(this number may be higher in some early 700's which have three output transistors per bank, or if no VARIAC is being used to drop the line voltage).

c) Replace any output transistor whose emitter resistor voltage reading varies more than ±20% from the typical. Also verify that the emitter resistor itself is not defective.

6-2. UNIT WILL NOT ENERGIZE PROPERLY

Occasionally when a 700/700B is turned on there may be a condition where there is sufficient leakage in an output transistor or it may short out in such a way that the supply fuse(s) may not blow, passing the 100V supply voltage to the speakers. The display meter(s) for the defective channel will usually peg at full output deflection. This symptom should be troubleshot as if a shorted output transistor condition existed. This also reinforces the need for external speaker fusing as described on page 5.

6-3. OUTPUT MALFUNCTION — NO LOAD CONNECTED

6-3.1 No output, one or both channels.

a) Check for blown supply or line fuse(s); refer to section 6-1, page 20.

b) With line cord disconnected from AC outlet, check all PC board semiconductors as described under heading 6-0 on page 20.

6-3.2 Excessive current drawn when voltage applied to the line cord.

a) Check the bias transistors carefully(Q6); replace if in doubt.

b) Check output transistors and output drivers, section 6-1.

c) Check all PCB semiconductors as per heading 6-0, page 20.

d) Isolate protection circuit as outlined in section 6-3.3 below.

6-3.3 Truncated or asymmetrical wave form output.

a) Verify matched power supply voltage readings at the filter capacitors in the power supply. There should be no more than 1 volt difference between the positive and negative supply readings. Typical supply voltage will be 100–105V.

b) Protection circuit isolation: disconnect one end of diodes D9 and D10(D8 and D9 on PL0171 PCB)and repeat the test. If the problem is now removed check and replace D9, D10, Q8, Q9, Q13 and Q14(D8, D9, Q7, Q8, Q12 and Q19 on PL0171 PCB–700).

c) Check predrivers Q10 and Q7(Q10 and Q17 on PL0171 PCB), and check output drivers Q11 and Q12(Q11 and Q18 on PL0171).

d) Possible defective Class A stage; check Q5, D4 and D5 (Q9, D3 and D4 on PL0171 PCB).

6-3.4 Oscillations. (Also see PROTECTION CIRCUIT, page 25.

a) Check RC output pole network R47/48,C19(R70/72,C24 on model 700). Replace if doubtful.

b) Replace predrivers Q7 and Q10(Q10 and Q17 on PL0171 PCB).

c) Replace output drivers Q11 and Q12(Q11 and Q18 on 700).

d) Check output transistor insulators. Occasionally the output transistor can pinch through the insulator as a result of thermal cycling, overtightening or previous replacement in which screw or socket metal particles become pinched between the insulator and heatsink. If this if found to be a touble spot and the insulators used are the rubber(pink or gray)self-lubricating type it is recommended that these be replaced with the mica type with thermal compound applied to them.

e) If oscillations(bursts) occur just before rated output at low test frequencies, be sure that line voltage at the line plug is maintained at 117-120VAC.

NOTE: On some model 700B amplifiers several ferrite beads are positioned on the output stage buss wiring. These are placed at the factory on a per-unit basis for maximum high frequency stability and it is recommended that they not be removed or altered in location.

On 700 amplifiers which oscillate it may be necessary to place ferrite beads on the output buss wiring(usually the output base buss wire). These are placed by experimental location.

6-4. OUTPUT MALFUNCTION INTO A LOAD

6-4.1 Unit will not deliver 53VRMS into 8-ohm load.

a) Check for line or VARIAC voltage sag; voltage at the line plug must be at least 117VAC when delivering full output.

b) Possible defective output transistor or output driver; see section 6-1, page 20-21.

6-4.2 Asymmetricaly or truncated wave form output.

a) Isolate protection circuit as outlined in section section 6-3.3 b) on page 22.

b) Check for balanced power supply voltages as described in section 6-3.3 a) on page 22.

c) Check for defective output transistor emitter resistors and/or open output transistors; see section 6-1.2 on page 20 and section 6-1.3 on page 21.

6-5. EXCESSIVE DISTORTION

6-5.1 Bias adjustment. Check and adjust the pre-driver bias as follows:

a) Allow the unit to warm up sufficiently. Ideally, the bias should be adjusted after the unit has achieved normal operating temperature.

b) Remove all input and output connections to the amplifier. Locate R38 and R39(10-ohm,½-watt)in each output bank(R47 and R62 on model 700's).

c) Measure the DC voltage drop across R38(R47 on a 700); verify a reading of 300–400mV DC and adjust R20 on the PC board(R36 on a 700 PL0171 PCB)to obtain this reading. Once this measurement is obtained measure the DC voltage drop across R39(R62 on model 700)and verify that it is within 20% of R38(or R47 on the 700).

NOTE: For amplifiers used in sound reinforcement or commercial use it is recommended that the bias be adjusted closer to 300mV across R38(R47). This will increase distortion only slightly, but will provide for much cooler operating temperatures. The cooling fan is still recommended, however.

6-5.2 THD analyzer adjustments.

a) Activate the 80kHz filter on the analyzer if it is so equipped and repeat THD measurement.

b) Examine test bench grounding system for possible ground loops. Ground the analyzer directly to the 700 output ground, not to the load, scope or meter grounds. Use 16 gauge wire for the ground system.

c) Reverse the line cord polarity by removing the line plug from the AC outlet, reversing it and plugging it in again.

6-5.3 Defective protection circuit.

Refer to section 6-3.3 b) on page 22.

6-6. EXCESSIVE DC OFFSET VOLTAGE

Model 700:
a) Remove all inputs to the amplifier. Monitor the offset voltage at the output of the left channel. With front panel input sensitivity controls closed(fully CCW)adjust DC offset by R17 on the PC board. Then with the front panel input control open(fully CW)adjust offset by R7 on the PC board. It may be necessary to repeat the adjustments since one will slightly affect the other. Repeat the procedure for the right channel. Offset should be less than 50mV at any level position.

b) If DC offset cannot be zeroed(less than 50mV)using the above procedure replace differential pairs Q4/Q5 or Q2/Q3 and readjust as per the above step a).

Model 700B:
a) The DC offset in the PL14 or PL20 PC boards is determined by matching of the first differential pairs in each channel. If DC offset measures more than 50mV replace Q1 and/or Q2. Occasionally Q3 and/or Q4 may affect offset as well.

6-7. PROTECTION CIRCUIT MALFUNCTION

6-7.1 Supply fuses open when amplifier outputs are shorted.

This indicates that the protection circuit is not shunting drive current properly.

a) Check/replace Q8,Q9 and D9–D12(Q7,Q8,D8–D11 on PL0171 PCB).

b) Check/replace R40–R42,Q14 and Q13(R63,R69,R48,Q12 and Q19 for a model 700).

c) Perform step 5-7 on page 20 after defective devices have been replaced to verify proper protection circuit operation.

6-8. MISCELLANEOUS MALFUNCTIONS

6-8.1 Low output at low frequencies.

This is usually caused by a defective capacitor or resistor in the negative feedback loop. Replace C6(100/10v lytic), R13 and/or C4.

6-8.2 Hum.

a) If hum is heard through loudspeakers in a home system be sure that the preamp is not stacked directly above or beneath the power amp. The 700/700B power transformer radiates a very large hum field which can be picked up by poor or non-shielded high-gain circuitry.

Also, flourescent lighting in the vicinity of the power amp can inject hum into the power supply as can AC line rheostats("dimmer switches").

b) Remove the line plug from the AC outlet and reverse the polarity by turning the plug over and plugging it back into the AC outlet.

c) Tighten the 7/16" power transformer bolts since a loose lamination can vibrate at line frequency and be transmitted into the signal.

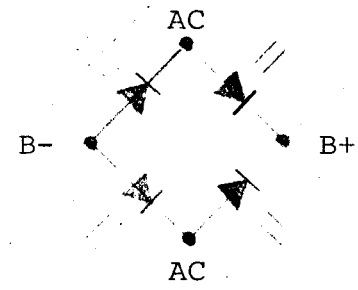
d) Be sure the terminals at the power supply filter capacitors are tight.

e) Tighten the ½" nuts which attach the input jacks to the chassis(this can be done externally on the 700B; on the 700 the top cover must be removed and the jacks tightened from inside).

6-8.3 Radio Frequency Interference(RFI).

Most RFI from a 700/700B is radiated by the bridge rectifier in the power supply.

a) Connect four .01/1000v ceramic or mylar capacitors across each terminal of the bridge rectifier as shown:



b) If existing rectifier used is a Sensitron device it can be replaced with a Motorola(MDA-990)type which characteristically has lower RF radiation.

c) Contact the Phase Linear Service Department for further RFI countermeasures.

6-8.4 Turn-off noise.

A delayed turn-off noise(usually a thump) is characteristic of the 700 and 700B amplifiers. This is caused by the power supply voltage discharging through the front end differential transistors, and should be a fairly low level noise. If the noise is extremely loud and poses a possible threat to the loudspeakers connected to the amp the following measures, applicable only to the model 700B, should be observed:

a) Replace D3 in the defective channel and check C3.

b) Check/replace Q1 and/or Q2.

c) Check/replace Q3 and/or Q4.

The model 700 has very little that can be done about turn-off noise aside from experimental matching of the front end differential transistors.

An alternative to any of the above procedures for both the 700 and 700B is the installation of an output relay which insures elimination of any turn-off noise. The associated PC board which accompanies the relay also provides a delayed voltage to the relay coil to eliminate any turn-on noise, and also incorporates subsonic and DC frequency protection. Contact the factory service department for details and availability.

7-0. SERVICE BULLETINS and SUPPLEMENTS

The following section is devoted to the inclusion of any factory bulletins pertaining to the models 700 and 700B.

Phase Linear

20121 - 48th Avenue West, LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

SERVICE BULLETIN #7721

Subject: 700B protection circuit

During the protection circuit test (page 15, Step #8 of 700(B) Service Manual) some 700B amplifiers may exhibit severe high-frequency oscillation in the short-circuit mode, often accompanied by the opening of the negative supply fuse. Any 700B which exhibits this problem should be modified as follows:

1) Desolder C17 (.05 mf ceramic) and discard.
2) Obtain a 130/½watt resistor and a .005/100 v. capacitor.
3) Solder the series RC network across the base-collector junction of Q9 (2N1305) on the foil side of the PC board as shown in the diagram below.
4) Perform the protection circuit test once again and verify the proper operation of the modified protection circuit.

Note: 700B's with serial number greater than 4250 contain the above modification already.

Phase Linear

20121 - 48th Avenue West, LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

SERVICE BULLETIN 1-80

IMPORTANT!! ALL PHASE LINEAR PRODUCT SERVICING PERSONNEL PLEASE READ...

SUBJECT: Models 400 Series, 700 Series, and D-500 amplifier output transistors and output driver transistors.

Since Phase Linear amplifiers began production several years ago we have incorporated several different types of output transistors and a few variations on output driver transistors. *Only* those which we have used in the past have been tested and approved by our engineering department for use in Phase Linear amplifiers. It is very important that ALL OUTPUT TRANSISTORS USED IN PHASE LINEAR AMPLIFIERS BE THE SAME IN EACH CHANNEL, that is, they must match by make and device number. Mixing output transistors in the same channel will adversely affect performance, reliability, and/or thermal stability. Therefore when replacing defective output transistors be sure to use only the same make and number used in that particular channel.

The following is a list of output transistors used in the past and their disposition. *Only* these devices have been approved for use in any of the 400 or 700 series amplifiers. Do not attempt to cross-reference these devices to another type of output transistor (2N, Sylvania ECG, etc.) since in the past the use of these devices has resulted in various kinds of amplifier malfunctions or direct failures. Also notice that the model Series Two D-500 uses *only one type* of output transistor (TP9054).

TP9054 (Motorola) - used in some production runs of Series Two model 400II and 700II. This is a higher voltage (and subsequently more expensive) device than the other output transistors. The model D-500 uses TP9054's *exclusively;* no other output transistor should be used in this amplifier. TP9054 is our own number stamped on Motorola MJ15024 devices. If MJ15024's are available locally they may be mixed with TP9054's in the same channel; this is one of *only two* exceptions to the mixed output rule (see XPL909).

XPL909 (Delco) - used in original 400's and 700's to the present. Some early XPL909's were marked PL909 and should not be confused with the Fairchild PL909 transistor. Delco PL909's are marked with *blue* ink and should be considered as XPL909 when ordering replacements. XPL909 is our own number stamped on selected Delco DTS411 devices. If DTS411's are available locally they may be mixed with XPL909's in the same channel. This is one of *only two* exceptions to the mixed output rule (see TP9054). XPL909's are no longer used or stocked as replacement parts.

F
PL909 or FPL909 (Fairchild) - notice the 'F' above PL909. This is how the number appears on the device. Do not confuse Fairchild PL909's with early Delco PL909's. All Fairchild PL909's are marked with *black* ink and should be considered as FPL909 when ordering replacements.

XPL910 (Delco) - these are power Darlington devices and are no longer used in production. Be sure not to confuse or mix these with XPL909's since the design markings on both devices are identical.

1B05 (RCA) - this is RCA's number and these should be available locally. They are no longer used in production.

MJ15011 (Motorola) - this is Motorola's number and these should be available locally. They are no longer used in production.

SE230 (Sensitron) - may be found only on very early model 400's. This is Sensitron's number and these may be available locally.

(cont.)

PL909A (Motorola) - notice the 'A' suffix. These may be found only on very early model 400's and possibly an early 700. These were found to have inconsistent reliability traits and should *all* be replaced in the amplifier whether good or defective. See exchange policy below.

2SD555 (NEC) - was never used in production runs of 400 or 700 series but is a suitable replacement transistor and is slightly more expensive than other outputs. These should be available locally.

Exchange Policy. Since some of the approved output devices have been dropped from our production runs and others are no longer stocked it may be necessary to replace all of the output transistors in one channel of an amplifier if duplicate replacements are not available.

We will be glad to exchange good (non-defective) output transistors for what we have currently available in stock at no charge *providing that* there be included with the transistors returned a note or letter stating the reason for the return and that the transistors being returned are not defective. Also you may wish to state a preference for which devices you would like to receive as replacements, though we cannot always honor your request since we are limited to what we have in stock at the time. Due to the higher cost, TP9054 or 2SD555 devices cannot be sent as direct replacements.

Output Drivers,. We have used only two types of output drivers in the past though three different types may be used (see below). The output driver is the *bottom* transistor in each of the output banks of the amplifier. OUTPUT DRIVERS MUST NOT BE USED AS OUTPUT TRANSISTOR SUBSTITUTES AND VICE VERSA. Output drivers *may* be mixed in the same channel without adversely affecting performance or reliability.

66546 (RCA) - this is our own number stamped on RCA 410 devices which may be available locally.

SJ2741 (Motorola) - found on early model 400's and 700 series amplifiers. May also be listed by Motorola as MJ2741 and should be available locally.

MJ1800 (Motorola) - standard Motorola number and should be available locally.

SPECIAL NOTE

We occasionally receive comments from field technicians that our output transistors read "leaky" on transistors testers and therefore cannot be used in a Phase Linear amplifier. Our engineering department has determined that due to the low gain/high current characteristics of these devices, standard transistor testers are *totaly invalid* in checking for bad outputs in this application.

The only valid test we have found is an in-circuit operational test with the amplifier on and loaded. This test procedure can be found in any of the amplifier service manuals in the Troubleshooting Guide section under "Current Sharing Test" or "Operational Output Transistor Test".

Phase Linear

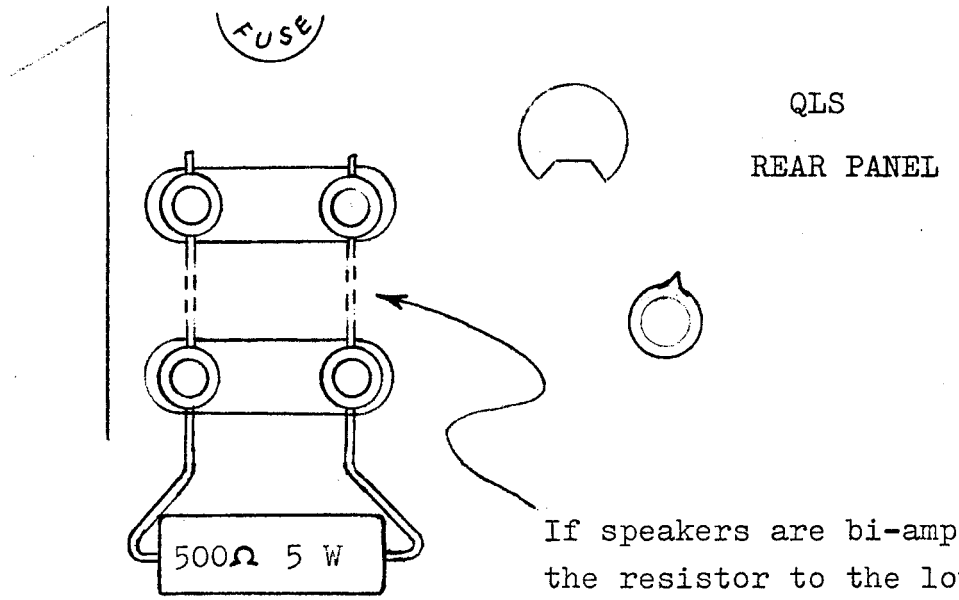
20121 - 48th Avenue West, LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

BULLETIN

SUBJECT: INFINITY QUANTUM LINE SOURCE SPEAKERS COUPLED WITH PHASE LINEAR POWER AMPLIFIERS

Recent field reports have shown an abnormally high failure rate on various power amplifiers coupled with any of the Infinity Quantum Line Source Speakers, among these the Phase Linear Model 400 and 700(B) amplifiers. After obtaining a set of QLS speakers here at the factory, our tests revealed that the 3000 mfd coupling capacitors in these speakers created a potentially hazardous condition to the power amp when switching the power off and then back on again before these large capacitors have fully discharged. We have discussed our findings with Infinity who has officially authorized our proposed modification which will eliminate the interface problem.

BEFORE OPERATING OR CONTINUING TO OPERATE ANY OF THE QLS SPEAKERS WITH PHASE LINEAR OR OTHER AMPLIFIERS, IT IS RECOMMENDED THAT AN APPROXIMATELY 500 OHM 5 WATT RESISTOR BE INSTALLED ACROSS THE TERMINALS OF EACH SPEAKER AS SHOWN IN THE DIAGRAM BELOW.



If speakers are bi-amped, connect the resistor to the low frequency input only.

Phase Linear CORPORATION
20121 - 48th Avenue West, LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

SERVICE BULLETIN

SUBJECT: GES 97 pin out change.

GE has recently discontinued the triangular or offset pin configuration (TO-18) used on their GES 97 transistor and changed it to the in-line pin configuration (TO-92). The GES 93 will also be changed in the future. The two versions look identical except for the pin out so be sure to check the pin configuration before installing a GES 97 of GES 93 in one of our products.

BOTTOM VIEW

TRIANGULAR (TO-18)

GES 97
TIS 97
GES 93
TIS 93
KA 1778*

IN-LINE (TO-92

GES 97
TIS 97
2N5401
MPS A-42
MPS A-55
MPS A-93
MPS 5172
MPS 8599
FPN 3569
FPN 4355
KA 1778*

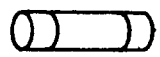
*The in-line version of the KA 1778 has the same pin out as triangular package.

Phase Linear

P.O. BOX 1335 LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

EARLY 700 METER LAMP REPLACEMENT

A few of the very early 700 units are equipped with VU meters which contain small fuse-type lamps mounted inside the meter.

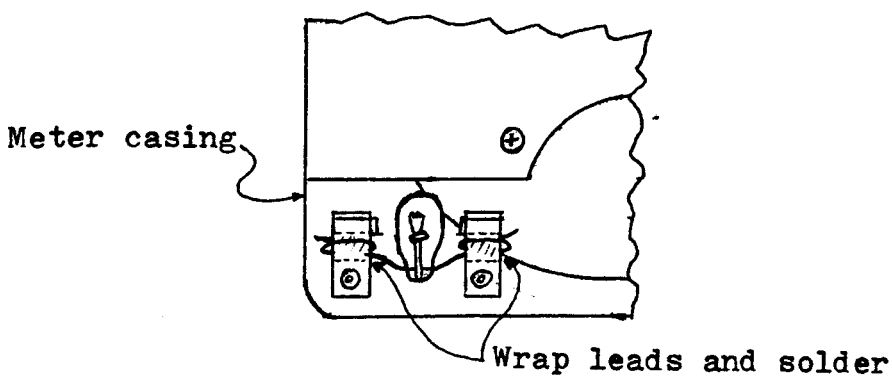


Small fuse-type lamp (actual size)

Unfortunately we have been unable to obtain any replacement lamps from the manufacturer. If you encounter a unit in which one or more of these lamps is burnt out, use the following procedure to restore proper meter lighting.

1) Remove all four of the fuse-type lamps from the meters
2) Obtain four #1784 meter lamps, supplied with the repair kits or obtainable from the factory on request.
3) Wrap and solder the leads of the #1784 lamps to the meter clips as shown in the diagram below.

Be sure to replace all four of the fuse-type lamps, for the #1784 lamps are significantly brighter.



CABLE ADDRESS: PHASE – Seattle, Wa. BANK: Peoples National Bank, Main Branch, Seattle, Wa.

9

700 - 700B Service Manual

Prepared 6/76

CONTENTS

I. Specifications
II. Circuit Description
III. Schematic and Design History
IV. Disassembly
V. Test and Alignment Procedure
VI. Troubleshooting Guide

Original

9

I. TECHNICAL SPECIFICATIONS

The following specifications comply with the current FTC Ruling on power amplifiers:

POWER: 345 WATTS PER CHANNEL MINIMUM R.M.S. AT 8 OHMS FROM 20HZ, WITH NO MORE THAN .25% TOTAL HARMONIC DISTORTION.

Sensitivity: 1.75 volts for 345 watts into 8 ohms.
Input Impedance: 100K nominal, reduces to 10k at full clockwise rotation of level control in normal or D.C. mode.
Hum & Noise: A minimum of 100dB below 345 watts.
Damping Ratio: A minimum of 1000:1 at 20Hz.
Rise Time: Less than 1.6 microseconds.
Phase Shift: Lagging 10 degrees at 20k Hz.
Optional Accessories: Walnut cabinet.

II. CIRCUIT DESCRIPTION

Main Circuit Board PL0171

Input signal is applied to the base of Q2 from one of two switch (S2) selectable sources. Switch S2 applies the output of emitter follower Q1 or a signal applied from the direct input jack. The R-C combination in the emitter of Q1 serves as a time delay circuit to prevent turn-on transients from reaching the base of transistor Q2 for approximately one second. The output of the differential pair comprised of Q2 and Q3 is applied to a second differential pair, Q4 and Q5. Differential amplifier Q4 and Q5 provide single-ended output which is applied to the base of Q9. Q9 provides the final voltage gain to drive the predriver transistors, Q10 and Q17. The P.N.P. predriver Q17 serves as a phase inverter to drive the negative output driver transistor Q18. The emitter of Q18 drives the paralleled emitter follower output transistors Q19, Q20, Q21, Q22, and Q23. The positive half of the signal is amplified by emitter follower Q10, which in turn drives the paralleled outputs Q11, Q12, Q13, Q14, Q15, and Q16.

Level control R4 controls the input signal applied to the base of Q2. It is operational only when the signal is received on the normal input jacks. R7 and R17 are D.C. offset adjustments which serve to null out small VBE differences between Q2 and Q3.

Diodes D5, D6, and D7 provide forward bias to the bias regulator transistor Q6. R36 adjusts the slight amount of forward bias necessary to provide a few milliamps of idling current in the driver transistors. This prevents cross-over distortion.

The patented protection circuit consists of Q7, Q8, and their associated R-C and diode networks. If the output current flowing through R48 and R69 becomes dangerously large, capacitors C19 and C20 acquire a voltage through R43 and R54 to cause Q7 and Q8 to turn on. Q7 and Q8 then cause D10 and D11 to also turn on. Drive current is shunted through D10 and Q11 around the predriver Q10, preventing an uncontrolled increase in output current. Diodes D10 and D11 prevent activation of the protection circuits when the amplifier is driving a reactive load. D12 and D13 are flyback diodes which prevent reverse overvoltage from appearing across the output transistors in the event an inductive load is switched.

S2 and S3 are switches thermally attached to the heat sinks. They will remove power if the heat sinks become too hot for safe operation.

Main Circuit Board PL14A and PL14B Series

Input signal is applied to the base of Q1. The output of the differential pair comprised of Q1 and Q2 is applied to the second differential pair, Q3 and Q4. This second differential provides single-ended output which is applied to the base of Q5. Q5 provides the final voltage gain to drive the predriver transistors Q7 and Q10. The P.N.P. predriver serves as a phase inverter to drive the negative output driver transistor Q12. The emitter of Q12 drives the paralleled emitter follower output transistors Q14, Q16, Q18,etc. The positive half of the signal from Q5 is amplified by emitter follower Q10, which in turn drives the paralleled outputs Q13, Q15, Q17, etc., through output driver Q11.

Main Circuit Boards PL14A & PL14B (Cont'd)

Diodes D6, D7 and D8 provide forward bias to the output bias regulator transistor Q6. R20 adjusts the slight amount of forward bias necessary to provide a few milliamps of idling current in the driver transistors, which minimizes crossover distortion.

III. SCHEMATICS AND DESIGN HISTORY

Schematics and Layouts:

Every circuit board is identified by a number located on the foil side of the board. Be sure to use the schematic which corresponds to the identification number of the board you are working on.

Diagram III - 1) PL0171 Schematic

III - 2) PL0171 Layout

III - 3) PL14A Schematic

III - 4) PL14A Layout

III - 5) PL20B and PL20/185B Schematic

III - 6) PL20B and PL20/185B Layout

III - 7) PL17B and PL17/64500 Layout

NOTE: Whenever ordering parts, especially meters and lamps, be sure to include the serial number of the unit with your order.

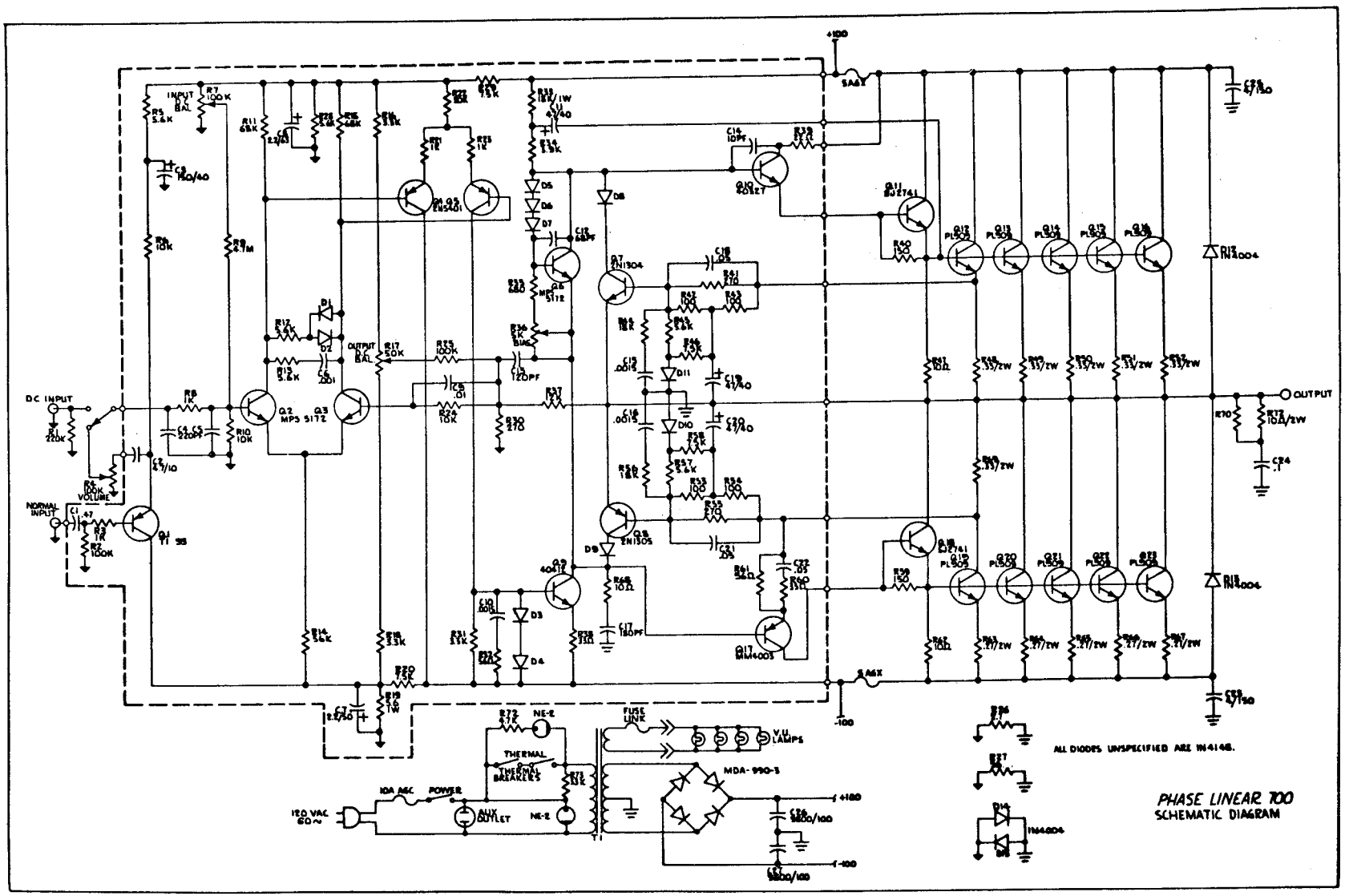


DIAGRAM III-1

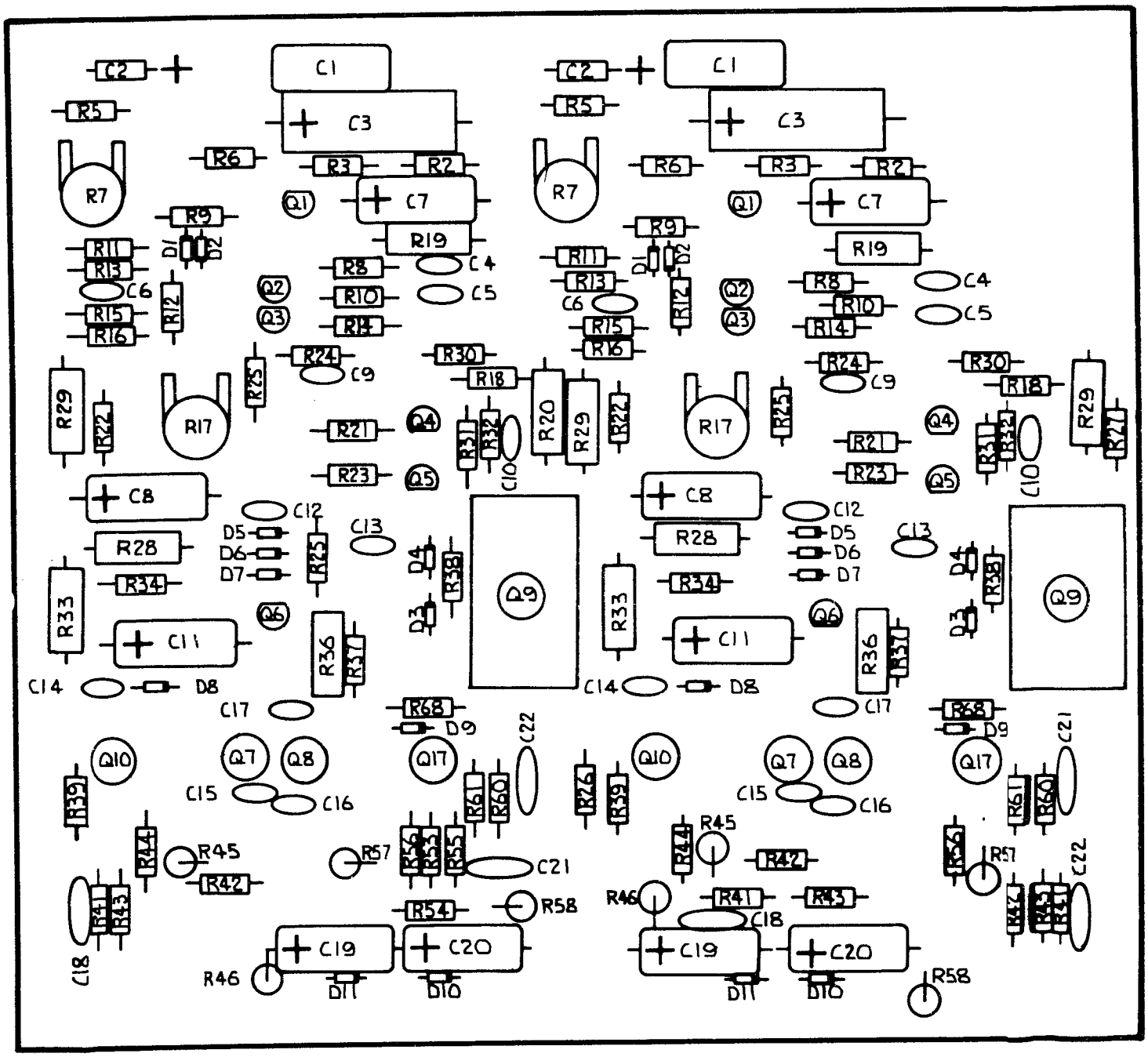


DIAGRAM III-2

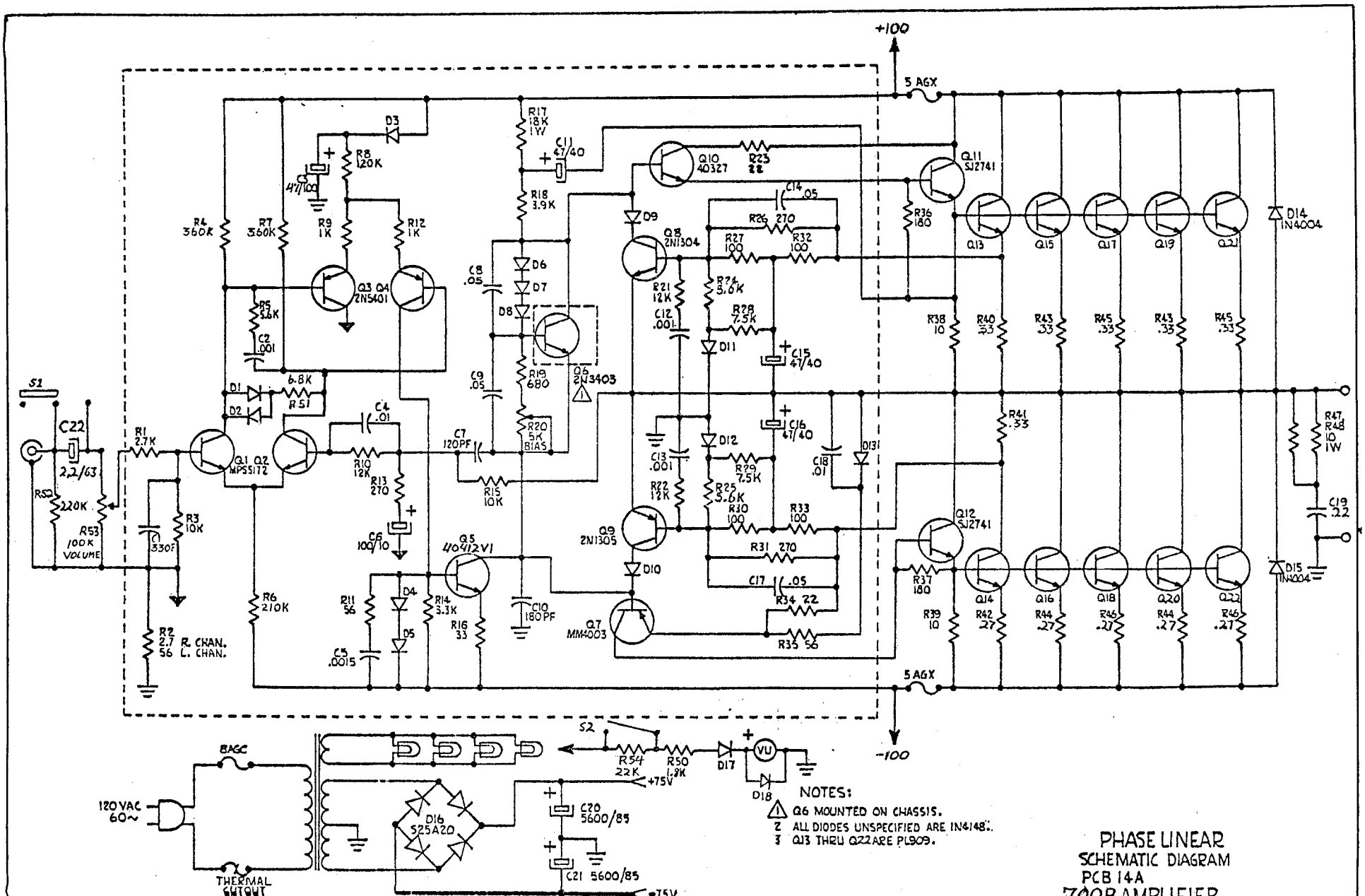
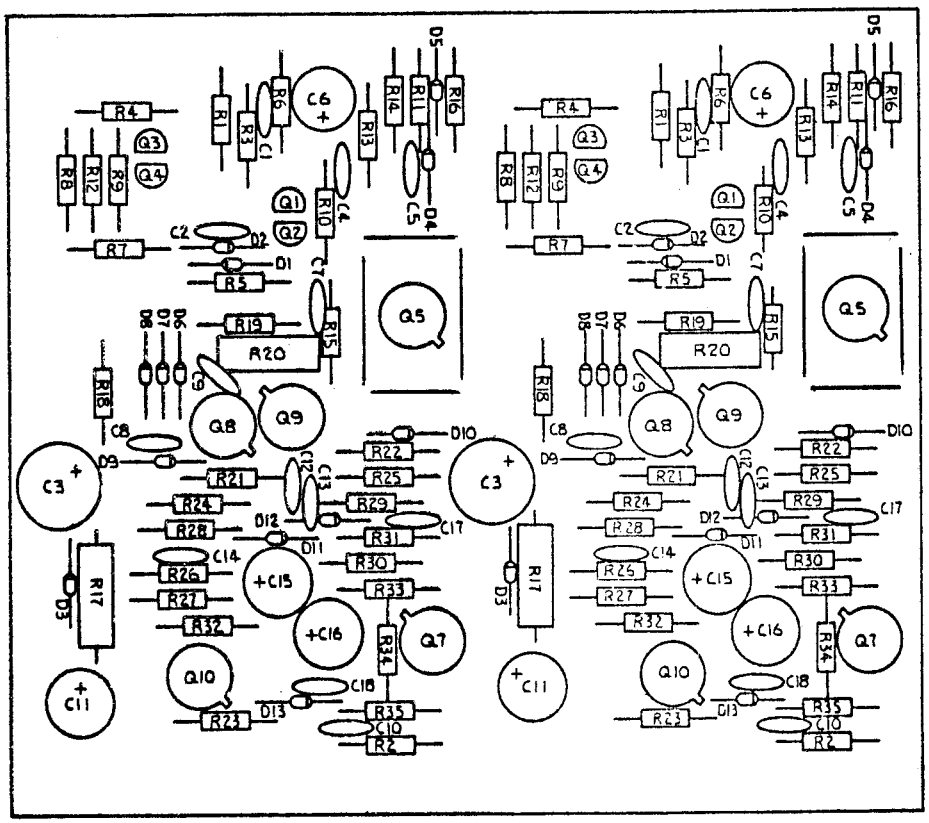
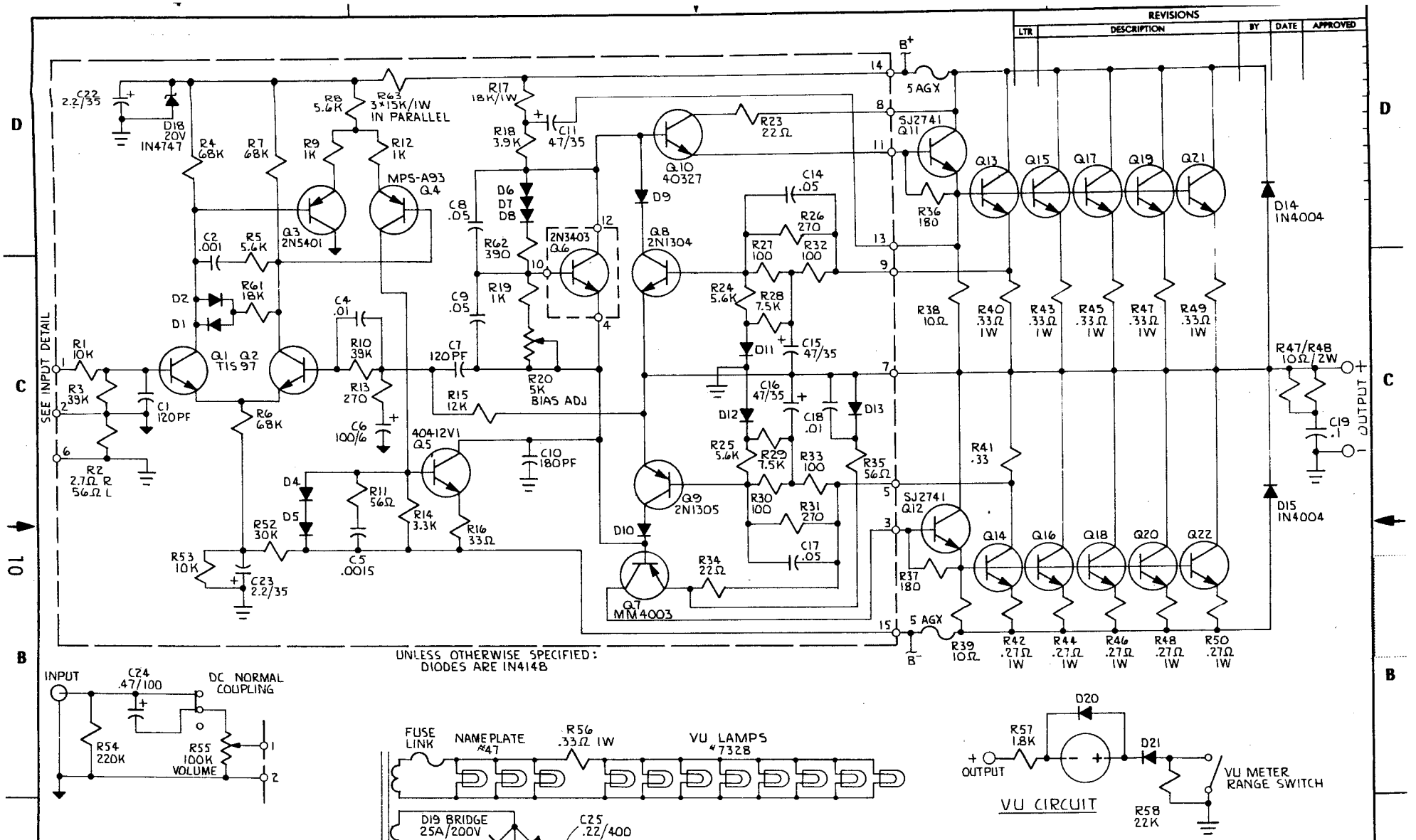


DIAGRAM III-3

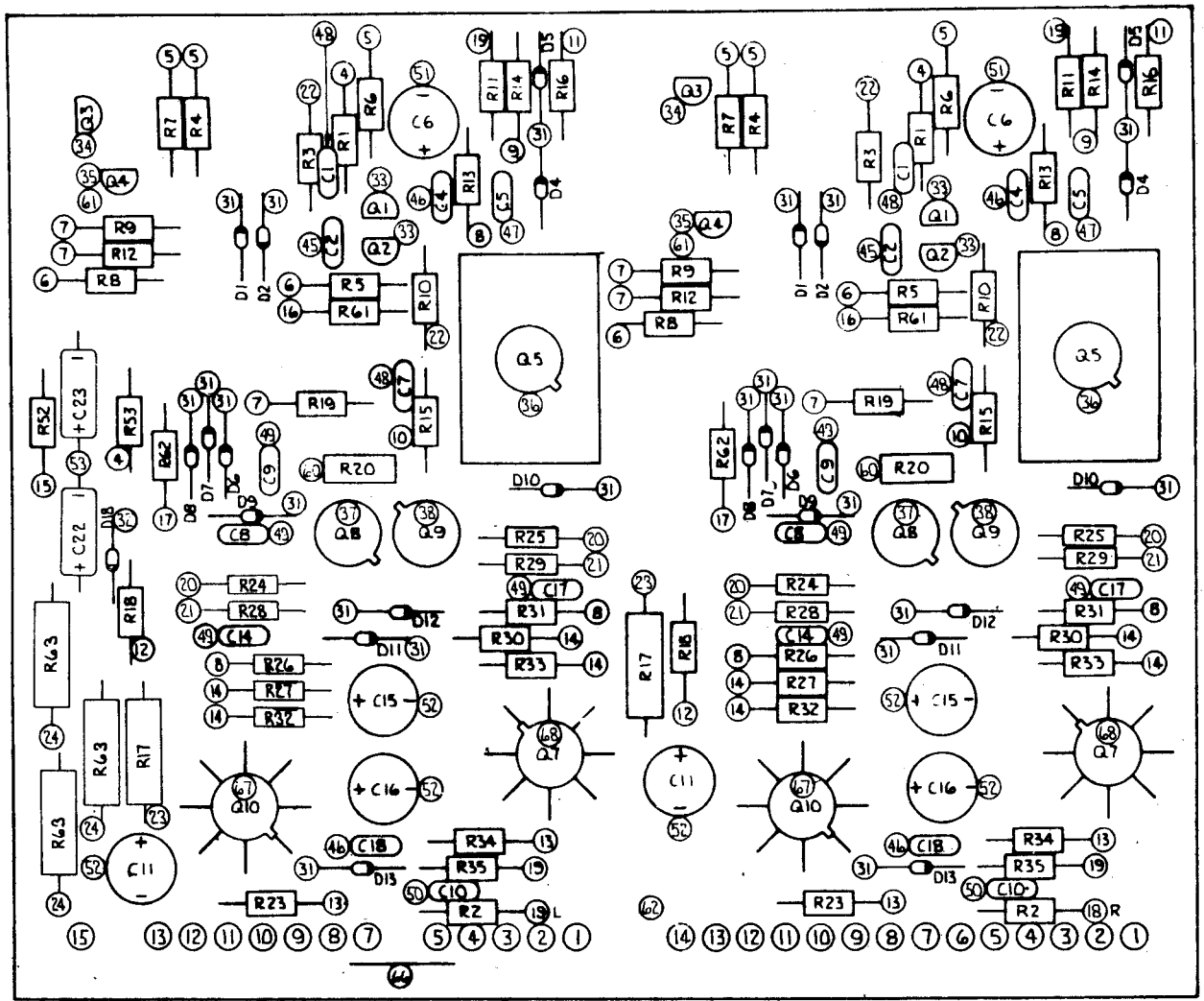


PHASE LINEAR
ASSEMBLY PCB14A
700B AMPLIFIER

DIAGRAM III-4


REVISIONS
LTR DESCRIPTION BY DATE APPROVED
SEE INPUT DETAIL
UNLESS OTHERWISE SPECIFIED:
DIODES ARE IN4148
B+
B-
5 AGX
SJ2741 Q11
SJ2741 Q12
Q10 40327
Q8 2N1304
Q9 2N1305
Q7 MM4003
2N3403 Q6
MPS-A93 Q4
Q3 2N5401
Q1 Q2 TIS 97
40412V1 Q5
D1 D2 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 IN4004 D15 IN4004
D18 20V IN4747
R1 10K
R2 2.7Ω R 56Ω L
R3 39K
R4 68K
R5 5.6K
R6 68K
R7 68K
R8 5.6K
R9 1K
R10 39K
R11 56Ω
R12 1K
R13 270
R14 3.3K
R15 12K
R16 33Ω
R17 18K/1W
R18 3.9K
R19 1K
R20 5K BIAS ADJ
R23 22Ω
R24 5.6K
R25 5.6K
R26 270
R27 100
R28 7.5K
R29 7.5K
R30 100
R31 270
R32 100
R33 100
R34 22Ω
R35 56Ω
R36 180
R37 180
R38 10Ω
R39 10Ω
R40 .33Ω 1W
R41 .33
R42 .27Ω 1W
R43 .33Ω 1W
R44 .27Ω 1W
R45 .33Ω 1W
R46 .27Ω 1W
R47 .33Ω 1W
R48 .27Ω 1W
R49 .33Ω 1W
R50 .27Ω 1W
R52 30K
R53 10K
R54 220K
R55 100K VOLUME
R56 .33Ω 1W
R57 1.8K
R58 22K
R62 390
R63 3*15K/1W IN PARALLEL
R47/R48 10Ω/2W
C1 120PF
C2 .001
C4 .01
C5 .0015
C6 100/6
C7 120PF
C8 .05
C9 .05
C10 180PF
C11 47/35
C14 .05
C15 47/35
C16 47/35
C17 .05
C18 .01
C19 .1
C22 2.2/35
C23 2.2/35
C24 .47/100
C25 .22/400
C26 9800/100
C27 9800/100
Q11 Q13 Q15 Q17 Q19 Q21
Q12 Q14 Q16 Q18 Q20 Q22
OUTPUT +
OUTPUT -
INPUT
DC NORMAL COUPLING
FUSE LINK
NAMEPLATE #47
VU LAMPS #7328
DI9 BRIDGE 25A/200V
THERMAL CUT OUT
ACCESSORY OUTLET
10 AGC
117 VAC
OFF-ON
T1
117/146 CT
B+ 100V
B-
POWER SUPPLY
VU CIRCUIT
VU METER RANGE SWITCH
DRAWN KNOBEL 9/9/74
CHECKED
APPROVED
RELEASE STATUS
PREL
FINAL
DO NOT SCALE DWG.
Phase Linear
ASSY 700B AMPLIFIER
SIZE C
DWG. NO. 402461
REV. D
SCALE:
SHEET OF
DIAGRAM III-5
ATTACHMEN 012345

REVISIONS				
LTR	DESCRIPTION	BY	DATE	APPROVED
E	UPDATED PARTS LIST & DWG.	S.P.	10-1-75	



700B UNIVERSAL PCB

SEE 402461 FOR SCHEMATIC

PL20B-02 ASSY

C-SAME AS 01 EXCEPT R63 ON BACK OF P.C.B.

01-SAME AS 02 EXCEPT C5 IS .0015MF.

UNLESS OTHERWISE SPECIFIED DIM AND TOL ARE IN INCHES AND SHALL BE INTERPRETED PER ANSI Y14.5 1966 TOLERANCES ARE 1 DEC ± .1 2 DEC ± .01 3 DEC ± .005 4 DEC ± .0005 ANGLES ± 0° 30' REMOVE BURRS BRK SHARP EDGES MACH SURFACES 125 MAT'L FINISH HT TREAT	DRAWN	KNOBEL	5 2 74
	CHECKED	Pedano	7 23 74
	APPROVED		
	RELEASE STATUS		
	PREL		
	FINAL		
	DO NOT SCALE DWG		

Phase Linear

PCB ASSY
700B PWR AMP

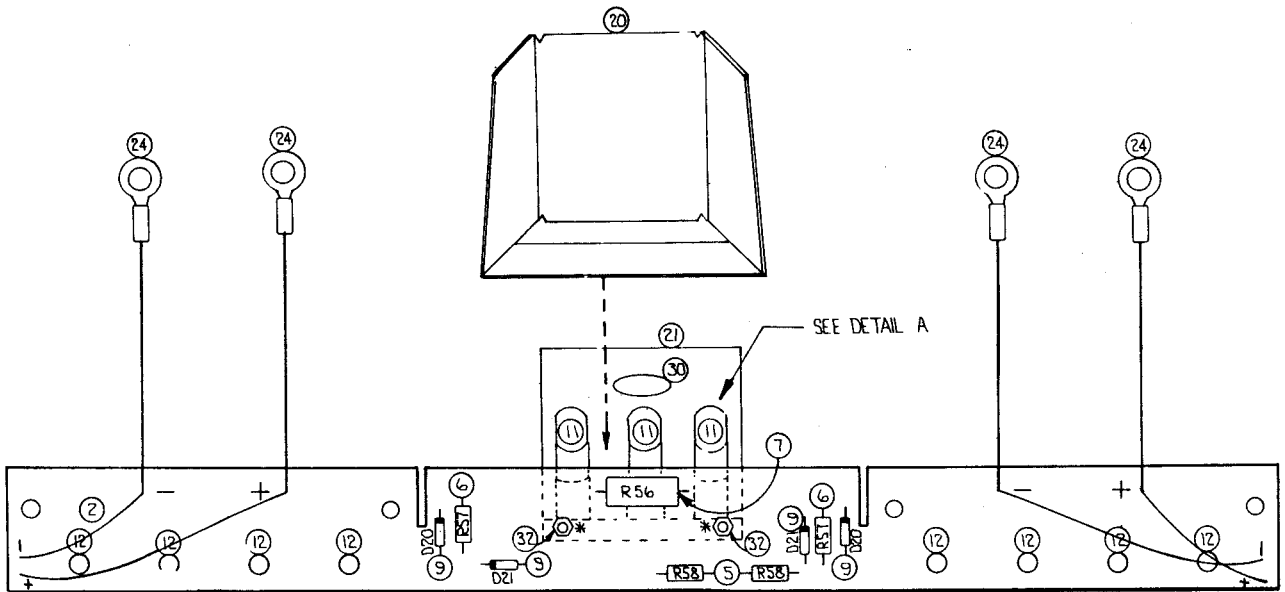
SIZE	DWG NO	REV.
C	402453	F

SCALE: SHEET 1 OF 1

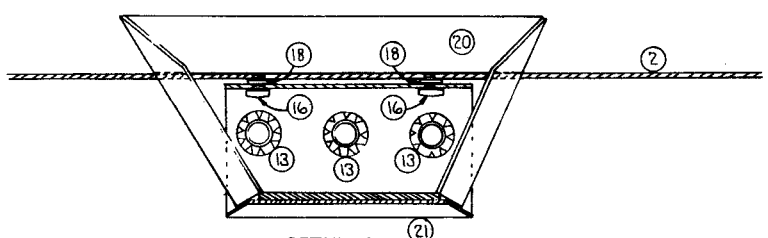
ATTACHMENTS 012345

DIAGRAM III-6

REVISIONS				
LTR	DESCRIPTION	BY	DATE	APPROVED



01 ASSY PL17 64500 (1)



DETAIL A

NOTE
FOR SCHEMATIC SEE DWG. 402461

UNLESS OTHERWISE SPECIFIED DIM. AND TOL. ARE IN INCHES AND SHALL BE INTERPRETED PER (ANSI) Y14.5-1966. TOLERANCES ARE: 1 DEC ±: .1 3 DEC ±: .005 2 DEC ±: .01 4 DEC ±: .0005 ANGLES ±: 0° 30'	DRAWN	PICKENS	9/17/74	Phase Linear
	CHECKED	Kmkl	9/18/74	PCB ASSY 700B METER BOARD
	APPROVED		/ /	
REMOVE BURRS, BRK SHARP EDGES MACH SURFACES 125	RELEASE STATUS			
MAT'L:	PREL.		/ /	
FINISH:	FINAL		/ /	
HT. TREAT:			/ /	
DO NOT SCALE DWG.			/ /	

SIZE		DWG. NO.	REV.
C	PL17	402456	A
SCALE:		SHEET 1 OF 1	

DIAGRAM III-7

ATTACHMEN 012345

IV. DISASSEMBLY

Step #1. Remove black top and bottom plates (10 phillips screws).

Step #2. Position the unit so that it rests on the heat sinks, with the front panel facing up.

Step #3. Remove the 4 front panel bolts, taking care not to scratch the front panel. Lift the front panel off and set it down on edge to the rear of the unit. Avoid straining the wire harness and be sure that the meter lugs do not short against the chassis.

Step #4. Remove the 4 hold-down nuts from the PL0171 board, or 2 hold-down nuts from the PL14A and PL20 boards, and flip the circuit board over and pull gently toward you. Before energizing the unit be sure that none of the PCB components are touching the rim of the chassis. The unit is now ready for test procedure.

Step #5. Re-assembly: Reverse the above procedure (NOTE: to ensure that the older 700 units will fit into a wood cabinet, align the front panel bolts so that one edge is parallel to the edge of the front panel).

V. TEST AND ALIGNMENT PROCEDURES

Step #1. Check all fuses: Verify AGX-5 or AGX-8 for supply and AGC-10 for line fuse.

Step #2. Drive the inputs with 200 Hz @ 0.5 volts. Observe the left channel output with scope, sweep 1 ms, amplitude 20 V/cm. DO NOT connect a load of any kind to the output terminals, other than the high-impedance scope, until instructed to do so in the following steps.

Step #3. Plug the 700B into a variable line transformer of sufficient power handling capacity, with line voltage at zero. Observing the scope, slowly turn up the variac to full line voltage. Verify proper signal at both outputs. If any of the fuses open or the signal is distorted, refer to Section VI in this manual.

Step #4. Still without 8-ohm load, drive each channel into clipping at 20 Hz, 200 Hz, 2K Hz, and 20K Hz. Verify proper output signal and symmetrical clipping.

Step #5. Now attach an 8-ohm, 250 watt load resistor in parallel with the scope input and drive each channel to clipping at 20 Hz, 200 Hz, 2K Hz, and 20K Hz. Verify at least 53 V RMS output just before clipping. NOTE: Be sure that the line voltage at the 700(B) line plug is between 117 and 120 VAC; the unit may not meet specs if the line voltage sags below 117 V.

Step #6. Bias adjustment: The bias network is adjusted at the factory under optimum conditions. Readjustment is required only when either the bias control pot is accidentally rotated or if the bias transistor Q6 has been replaced.

a) IMPORTANT: Allow at least 5 minutes warm-up time.
b) With all input and output connections removed, measure the DC voltage drop across R38 (R40 on PL0171) in each channel, with the negative meter probe on the output terminal side of this resistor. Verify approximately +0.35 VDC, ± 0.1 VDC. Any necessary adjustments may be make by rotating R20 (R36 on PL0171) the proper amount. NOTE: Avoid setting the bias voltage too high in order to obtain very low distortion readings--this may lead to excessive idling temperatures.
c) If harmonic distortion analyzer is available, measure the THD as follows: Apply 2K Hz signal to the inputs such that there is 3 V RMS at the output terminals (about 1 watt into the 8-ohm load). With the 8-ohm load resistor connected to the output terminal, measure the THD of each channel using the analyzer. Verify that the THD is less than .25%, typically .15% or less.

Step #7. Offset: There should not be more than about ± 75 millivolts of DC voltage at the output terminals. If a unit exhibits excessive offset:

a) 700B units containing PL14 or PL20 boards, replace Q1 and Q2 if offset exceeds ± 75 mv DC.
b) 700 units containing PL0171: Switch to normal inputs, rotate volume control fully counterclockwise. Zero the output offset by rotating R17. Now turn the volume control fully clockwise and zero the output offset by rotating R7. Repeat this step several times until the output offset remains zeroed at both the full clockwise and counterclockwise positions of the volume control.

Step #8. Protection circuit test. The following is a test to verify the proper operation of the protection circuit.

a) With variac at 0 volts, drive the input with 0.25 volts at 20 Hz.
b) Short circuit the left channel output terminals with a jumper wire.
c) Slowly turn up the variac from 0 to 117 V AC.
d) Remove the short circuit jumper and verify that the amplifier resumes normal operation.
e) If the unit blows fuses during step c, refer to Section VI.
f) Repeat steps a thru e for the right channel.

Step #9. Operational output transistor test. The following is a test to verify that all the output transistors are operational under load conditions. Because of the nature of these output devices, curve tracers and simple continuity measurements will often indicate transistors to be "leaky" when they are in fact functional. The following is a test for verification of proper current sharing of the output transistors.

a) With full line voltage, drive the unit to point of clipping at 200 Hz into the 8-ohm load resistor.
b) Turn the variac down to about 75% line voltage. Verify symmetrical clipping at the output.
c) Using a DC voltmeter, measure the voltage drop across the .33 and .27 ohm emitter resistors in the output banks. Typically these will read about 120 and 100 millivolts respectively. If any voltage reading varies more than 25% from the rest (or there is no voltage at all), the appropriate transistor(s) should be replaced after verifying that the emitter resistor itself is not damaged. Be sure to recheck the bank of outputs in which a transistor has been replaced.

VI. TROUBLESHOOTING GUIDE

The following section is an aid to troubleshooting a defective 700B. All known significant malfunctions are listed according to symptom with one or more probable causes, test and cures given to facilitate repair. This section will be continually updated in order to include any new problems which may be discovered. If you should have the misfortune of discovering some new and exotic problem, we would appreciate hearing from you so that we may include your discovery in this section. If you should need any additional assistance, please feel free to contact the factory service center.

A. Locating Defective Transistors.

The following are some procedures for locating or isolating defective transistors on the PCB or in the output stage without actually removing each transistor from circuit to measure it. (All measurements taken with unit off, filter caps discharged). Except for a very few cases, all transistors and diodes may be checked in circuit using an ohmmeter on the RX1 or RX10 scale, depending on the test voltage of the meter. (NOTE: There are some meters whose test voltage is too small to turn on most semiconductors). Actual readings may vary with different meters, but basically on a good device the meter will have a lower reading in the forward junction direction and a very much higher reading in the reverse direction.

1. Transistors and diodes on the PCB may be checked as follows:

   a) All diodes: Place the negative probe on the cathode, positive on the anode (forward direction); this will yield a lower reading (eg Fluke: 600 ohms, Volt-ohmist: 40 ohms), reversing the probes will yield a very high or infinite reading. NOTE: On PL14A,B, D13 will have a very low reading in both directions.

   b) For P.N.P. transistors (TIS 93, MPS A93, MPS A55, MM4003, 2N1305) place the negative probe on the base and read across the base-collector and base-emitter junctions for the lower (forward) reading. (Germanium 2N1305 will have lower forward reading.)

   c) For N.P.N. transistors, (TIS 97, MPS 5172, 40327, 2N1304, and 2N3403) place the positive probe on the base and read accross the base-collector and base-emitter junctions for the lower reading. (Germanium 2N1304 will have a lower forward reading.)

If there is a doubt in any of the readings, cross-check yourself by measuring the similar device in the other channel.

2. Isolating defective output transistors may be accomplished as follows:

   a) Remove all output connections and supply fuses.

b) Read across R36 and R37 (R40 and R59 on PL0171). A reading less than 150 ohms indicates a defective output driver.
c) Place the negative meter probe on the collector buss wire of one bank of output transistors. Touch the positive meter probe to the emitter of each of the output devices. If one transistor is shorted, they will all read very low (usually a fraction of an ohm) but one (or two) will read slightly lower than the rest, and that is the defective one. If they all read low and the same, repeat the above test with the negative probe on the base buss wire.

B. No signal. (NOTE: Power supply problems are common to both channels).

1. Meter lights not on: Check line fuse, line cord, thermal cutout.
2. Blows line fuse repeatedly:
   a) Check rectifier; replace if defective
   b) Check for shorted anti-hum cap across AC terminals of rectifier if any is present.
   c) Check for shorted filter capacitor and replace if necessary.
3. Hum or 60 cycle square wave in both channels: Check filter caps and screws.
4. Output goes positive or negative (in both channels).
   a) Check for symmetrical voltage at filter caps.
   b) Check for blown zener diode on PL400C board.
   c) Check for blown output transistors in both channels.
5. Output goes positive or negative in only one channel:
   a) Check for proper positive and negative supply voltage at the PCB (possible broken land or wire).
   b) Check for blown output transistor.
   c) Check Q1 thru Q5 on PCB.
   d) Check D4, D5 (D3, D4 on PL0171).

C. Signal and other things...

1. No positive or negative half of sine wave:
   a) Check for blown supply fuse.
   b) Check protection circuit: PL0171: Q7, Q8, D8, D9; PL20, PL14A,B: Q8, Q9, D9, D10. NOTE: disconnecting one leg of both of the diodes will remove protection circuit influence in most cases.
   c) Check predrivers, Q7 and Q10 (Q10 and Q17 on PL0171).
   d) Check output drivers and transistors.
   e) Check class A stage: PL0171: Q9; PL14A, PL20: Q5.
2. Severe crossover distortion:
   a) Check bias voltage as outlined in section V, step #6. Adjust bias trim pot if necessary (PL0171: R36; PL14, PL20: R20).

b) Check bias transistor Q6 and replace if necessary. Check also bias diodes D6, 7, 8 (D5, 6, 7 on PL0171).
c) On PL14A, PL20: Check diodes D1 and D2.

3. Severe motorboating, draws current, possibly blows fuses: Check bias transistor Q6.
4. Either channel latches up to positive or negative supply intermittently, pops, etc.: Check Q3 and Q4 on PL14A and replace with MPS A93 if they are 2N5401.
5. Blows fuse(s) on turn-on, with or without load: Check for blown output device (see beginning of this section).
6. Excessive noise: Replace Q1 and Q2; replace Q3 and Q4 if Q1 and Q2 do not fix PL14A, PL20.
7. Oscillation, one channel: Check output RC network (mounted on speaker terminals for bad solder joints, burned parts, etc.
8. One channel clips prematurely with load: Check all transistors and diodes in protection circuit; remove protection circuit--if problem is removed, replace the protection devices. If problem remains, suspect outputs or predrivers.
9. Slewing at high frequencies with load: Perform operational output test--possible defective or open driver or output.
10. Both channels clip prematurely with load: Measure voltage on main filter caps and replace if necessary.
11. Excessive output offset:
    a) On 700 units containing PL0171, zero offset as outlined in section V, step #7 b). If outputs still cannot be zeroed, replace Q2 and Q3 and repeat step #7 b) in section V.
    b) On 700B units with PL14 or PL20, there is no offset adjustment. If output offset exceeds $\pm$ 75 mv DC, replace Q1 and Q2.

VII. SERVICE BULLETINS

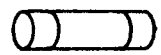
This section contains copies of all past service bulletins dealing with the 700-700B. Any future service bulletins you receive which may apply to the 700-700B should be placed in this section for your reference.

Phase Linear

P.O. BOX 1335 LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

EARLY 700 METER LAMP REPLACEMENT

A few of the very early 700 units are equipped with VU meters which contain small fuse-type lamps mounted <u>inside</u> the meter.

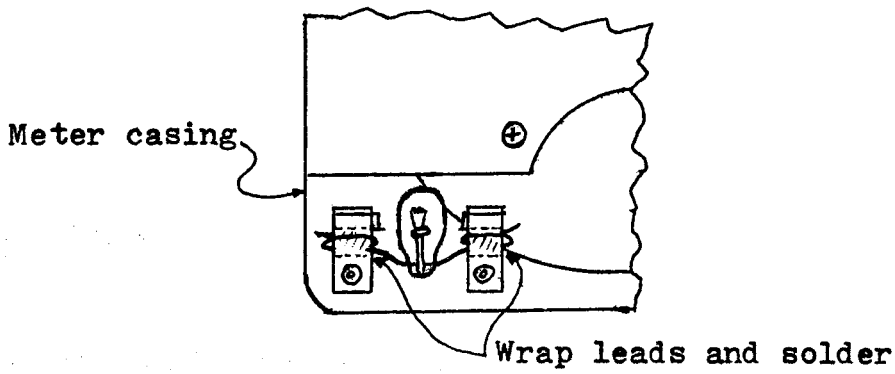


Small fuse-type lamp (actual size)

Unfortunately we have been unable to obtain any replacement lamps from the manufacturer. If you encounter a unit in which one or more of these lamps is burnt out, use the following procedure to restore proper meter lighting.

1) Remove all four of the fuse-type lamps from the meters
2) Obtain four #1784 meter lamps, supplied with the repair kits or obtainable from the factory on request.
3) Wrap and solder the leads of the #1784 lamps to the meter clips as shown in the diagram below.

Be sure to replace all four of the fuse-type lamps, for the #1784 lamps are significantly brighter.



CABLE ADDRESS: PHASE – Seattle, Wa. BANK: Peoples National Bank, Main Branch, Seattle, Wa.